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CENTRO DE BIOCIÊNCIAS
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CRISTIANO COELHO DO NASCIMENTO

AMANITACEAE (AGARICOMYCETIDAE, BASIDIOMYCOTA) NO NORDESTE BRASILEIRO

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Dissertação apresentada ao Programa de Pós-Graduação em Biologia de Fungos do Departamento de Micologia do Centro de Biociências. Área de Concentração: Micologia Básica, Universidade Federal de Pernambuco (UFPE), como parte dos requisitos para a obtenção do título de Mestre em Biologia de Fungos.
Orientador: Dr. Felipe Wartchow

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“O amor é como um rinoceronte, míope e impetuoso; se não consegue encontrar um caminho, criará um”.

(Adágio Femerefe)

“A menos que modifiquemos nossa maneira de pensar, são seremos capazes de resolver os problemas causados pela forma como nos acostumamos a ver o mundo”.

(Albert Einstein)

RESUMO

A família Amanitaceae possui distribuição mundial e desponta como um ramo distinto e bem conhecido de Agaricales, incluindo cogumelos de estimado valor gastronômico e também espécies produtoras de alcaloides letais. Compreende tradicionalmente os gêneros *Amanita* e *Limacella*, caracterizados pela presença de acrofisálides na trama do estipe. A família ainda é pouco conhecida nas regiões tropicais, especialmente para o Brasil. Assim, buscando contribuir para o conhecimento da diversidade de Amanitaceae, foram estudados materiais resultantes de coletas em áreas pontuais do nordeste brasileiro (APA Delta do Parnaíba, *Campus* I da Universidade Federal da Paraíba, Floresta Nacional da Restinga de Cabedelo, Reserva Ecológica Mata do Pau-Ferro, Reserva Biológica Guaribas SEMA I, Reserva Biológica Saltinho, Parque Estadual das Dunas do Natal). Além dos inventários, foram analisados materiais provenientes de empréstimo dos herbários UFRN – Fungos (Rio Grande do Norte), JPB (Paraíba) e URM (Pernambuco); e ainda materiais da coleção pessoal do Prof. Dr. Felipe Wartchow coletados no (1) Parque Nacional de Ubajara – **PNU** (CE), (2) Parque Estadual Serra do Conduru - **PESC** (BA) e na região entre os municípios de Abaíra e Itaetê, Chapada Diamantina - **AICD** (BA). Dezesseis espécies foram estudadas e estão distribuídas em dois gêneros, sendo 13 espécies novas: *Limacella brunneovenosa*, *Amanita dulceodora*, *A. eburneopileata*, *A. velutina*, *A. aureonitida*, *A. griseoesplendida*, *A. melliodora*, *A. aureonauseosa*, *A. alboturbinata*, *A. flavosulcatissima*, *A. helenae*, *A. fragilíssima*, *A. adamantina* e *A. griseocrenulata*; e apenas uma nova citação para o Brasil: *A. nauseosa*. *Amanita lippiae* e *A. psammolimbata* foram revisadas e redrescritas em uma nova seção (seção *Vaginatae* e *Phalloideae*, respectivamente). Para as espécies são apresentadas descrições, comentários, ilustrações e fotos dos basidiomas, além de chaves de identificação. Em adição, é apresentado um *checklist* comentado das espécies de *Amanita* que ocorrem na América do Sul.

Palavras-chave: Agaricales. *Amanita*. Morfologia. Novos táxons. Taxonomia

ABSTRACT

Amanitaceae has a worldwide distribution and is a distinct and well-known fungal family of Agaricales, consisting of many edible, as well as poisonous, even lethal, mushrooms. It traditionally comprises two genera: *Amanita* and *Limacella*, which are characterized by the presence of acrophysalides at stipe trama. The family is still little known in tropical regions, especially in Brazil. Thus, in order to contribute to the knowledge of the diversity of Amanitaceae, materials resulting from collections in some areas of the brazilian northeast were studied (APA Delta do Parnaíba, *Campus* I da Universidade Federal da Paraíba, Floresta Nacional da Restinga de Cabedelo, Reserva Ecológica Mata do Pau-Ferro, Reserva Biológica Guaribas SEMA I, Reserva Biológica Saltinho, Parque Estadual das Dunas do Natal). In addition, were analyzed materials deposited in herbaria [UFRN – Fungos (Rio Grande do Norte), JPB (Paraíba) and URM (Pernambuco)] and from personal collection of Dr. Felipe Wartchow collected in (1) Parque Nacional de Ubajara – **PNU** (CE), (2) Parque Estadual Serra do Conduru - **PESC** (BA) and in area between municipalities of Abaíra and Itaetê, Chapada Diamantina - **AICD** (BA). A total of 16 species belonging to two genera have been studied, from which 13 are new to science: *Limacella brunneovenosa*, *Amanita dulceodora*, *A. eburneopileata*, *A. velutina*, *A. aureonitida*, *A. griseoesplendida*, *A. melliodora*, *A. aureonauseosa*, *A. alboturbinata*, *A. flavosulcatissima*, *A. helenae*, *A. fragilíssima*, *A. adamantina* and *A. griseocrenulata*; and only one new citation for Brazil: *A. nauseosa*. *Amanita lippiae* and *A. psammolimbata* were critically re-examineted and transferred to section *Vaginatae* and section *Phalloideae*, respectively. Descriptions, notes, line drawings, and macroscopic pictures of the basidiomata are provided, along with identification keys. In addition, an annotated checklist of *Amanita* species from South America is presented.

Key-words: Agaricales. *Amanita*. Morphology. New taxa. Taxonomy

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LISTA DE ABREVIATURAS E SIGLAS

ADP - APA Delta do Parnaíba.

AICD - Abaíra e Itaetê, Chapada Diamantina.

EMC - Ectomicorrízico.

FLONA - Floresta Nacional.

FNRC - Floresta Nacional da Restinga de Cabedelo.

ITS - Espaçadores transcritos internos 1 e 2, que circundam o gene 5.8S e são flanqueados pelos genes SSU (18S) e LSU (28S).

nLSU - Gene da subunidade maior do ribossomo, também conhecida como 28S.

PCR - Reação em cadeia da polimerase.

PEDN - Parque Estadual das Dunas do Natal.

PESC - Parque Estadual Serra do Conduru.

PNU - Parque Nacional de Ubajara.

RBG - Reserva Biológica Guaribas.

RBP1 - O gene codificador da subunidade mais larga da RNA polimerase II.

RBP2 - O gene codificador da segundasubunidade mais larga da RNA polimerase II.

RBS - Reserva Biológica Saltinho.

REBIO - Reserva Biológica.

RMPF - Reserva Ecológica Mata do Pau-Ferro.

Tef-1α - Subunidade 1 alpha do fator de elongamento de tradução.

UFRN - Universidade Federal do Rio Grande do Norte.

UFPA - Universidade Federal do Pará.

UFPE - Universidade Federal de Pernambuco.

UFPB - Universidade Federal da Paraíba.

SUMÁRIO

1 INTRODUÇÃO

O Reino *Fungi* representa um dos mais abundantes e diversos clados de organismos que compõem a árvore da vida (BLACKWELL *et al*., 2012). Cerca de 100.000 espécies de fungos foram catalogadas, ocorrendo em praticamente todos os ecossistemas terrestres como parceiros mutualistas, patógenos, parasitas ou sapróbios (BLACKWELL & SPATAFORA, 2004; WEBSTER & WEBER, 2007; BLACKWELL, 2011; MOORE *et al*., 2011). Estimativas baseadas nos avanços da filogenia molecular e na extrapolação da razão plantas/fungos apontam para a existência de cerca de 2,2 a 3,8 milhões espécies de fungos, suplantando a estimativa conservadora de 1,5 milhões (HAWKSWORTH, 1991, 2001, 2004; LODGE, 2001; HAKWSWORTH & LÜCKING, 2017); nessa perspectiva, ao longo de mais de dois séculos de micologia, apenas 3%–8% das espécies estimadas foram descritas, colocando tais organismos como um dos recursos da biodiversidade menos estudados/explorados do planeta.

Entre as diversas localidades possíveis de se encontrar o imenso número de fungos ainda não explorados pela ciência, estão (1) países com conhecimento escasso de sua diversidade fúngica, (2) hospedeiros, hábitats ou nichos inexplorados e (3) ecossistemas pouco inventariados, especialmente as florestas tropicais (MCNEELY *et al*., 1990, HAWKSWORTH & ROSSMAN, 1997; HYDE, 2001; HAWKSWORTH, 2004; HAKWSWORTH & LÜCKING, 2017).

Os ecossistemas brasileiros destacam-se pela elevada diversidade biológica e alto índice de endemismo (MYERS *et al*., 2000; MINISTÉRIO DO MEIO AMBIENTE, 2016), repercutindo expressivamente para ocorrência de um grande número de espécies de fungos [estimativas apontam mais de 200 mil espécies (LEWINSOHN & PRADO, 2005)]. No entanto, o atual ritmo de destruição dos ecossistemas nativos tem sido muito mais rápido e eficiente do que os esforços de pesquisadores, entidades ambientais e poder público para conservar ou explorar racionalmente os recursos naturais que restam (MORELLATO, 1992). Nesse contexto, a realização de inventários micológicos em áreas ainda conservadas (ou mesmo não conservadas) compreende uma etapa fundamental para a expansão do conhecimento dos inúmeros grupos de fungos, servindo como base para as demais áreas de estudo, especialmente estudos ecológicos e biotecnológicos, além de contribuir de forma crítica para a saúde e estabilidade da biosfera.

Os cogumelos representam uma importante parte da diversidade fúngica há aproximadamente 300 milhões de anos (CHANG & MILES, 2004). Estes são incluídos em grande parte no subfilo Agaricomycotina (tradicionalmente conhecidos como

Hymenomycetes), sobretudo na ordem Agaricales (ou clado euagárico), a qual compreende mais de 13.200 espécies, distribuídas em cerca de 410 gêneros e 33 famílias (KIRK *et al*., 2008; MOORE *et al*., 2011). Tradicionalmente, a morfologia do basidioma, coloração da esporada e diversos caracteres anatômicos/citológicos têm sido amplamente utilizados na taxonomia e sistemática da referida ordem (MATHENY *et al*., 2006).

No entanto, essa abordagem tem levado ao estabelecimento de diversos grupos artificiais, uma vez que formas e estruturas similares podem evoluir de maneira independente e de diferentes modos (SHENOY *et al*., 2007; MOORE *et al*., 2011). Isso explica porque as modernas comparações derivadas de análises moleculares têm incitado diversas reavaliações na classificação tradicional desses organismos.

Especialmente as filogenias baseadas na análise do cistron rRNA nuclear e seus espaçadores, têm transformado drasticamente a classificação dos diversos grupos de fungos, notadamente Agaricales (MONCALVO *et al*., 2000, 2002; BINDER *et al*., 2002; LARSSON *et al*., 2004; MATHENY *et al*., 2006). O complexo ITS (*Internal Transcribed Spacer*) tem sido proposto como marcador primário para "barcode" de fungos, uma vez que apresenta alto grau de variação entre espécies intimamente relacionadas ou mesmo populações, sendo, portanto, largamente usado para identificação de espécies e resolução de grupos infragenéricos (HORTON & BRUNS, 2001; BRIDGE *et al.*, 2005; NILSSON *et al.*, 2008; SCHOCH *et al.*, 2012). Atualmente, mais de 172.000 sequências ITS de fungos encontram-se depositadas no *GenBank* (http://www.ncbi.nlm.nih.gov/genbank/), das quais 56% estão associadas a binômios latinizados, representando cerca 15.500 species e 2.500 gêneros, derivados de

O gene nLSU (*Nuclear Large Subunit*) vem se destacando como um marcador bastante útil em análises filogenéticas para os níveis de gênero e família, sendo empregado de forma isolada na inferência de topologias, ou em combinação com outros marcadores moleculares (ex.: ITS, Tef-1α, β-tubulina, RPB1, RPB2) em análises multi-*locus* (HIBBETT & THORN, 2000; FELL *et al.*, 2000; MONCALVO *et al*., 2000, 2002; SJAMSURIDZAL *et al*., 2002; SCHOCH *et al*., 2012; MATHENY, 2005). Destaca-se também como excelente marcador para o posicionamento de novas linhagens fúngicas (provenientes de estudos ambientais) em um arcabouço filogenético abrangente ou para análise de linhagens basais de tais organismos (JAMES *et al*., 2006; ÖPIK *et al*., 2010).

Amanitaceae R. Heim ex Pouzar representa um ramo distinto e bem conhecido de Agaricales, incluindo cogumelos de estimado valor gastronômico e também espécies produtoras de alcaloides letais (NEVILLE & POUMARAT, 2004; ZHANG *et al*., 2015). Compreende os gêneros *Amanita* Pers. e *Limacella* Earle (SINGER, 1986), cujos representantes exibem hábito marcadamente agaricoide; entretanto, algumas formas gasteroides (*Amarrendia* Bougher & T. Lebel) e secotioides (*Torrendia* Bres.) têm sido associadas a linhagens de *Amanita* (MONCALVO *et al*., 2002; JUSTO *et al*., 2010; YANG, 2011).

Estima-se que existam 900-1000 espécies de *Amanita* ao redor do globo, das quais metade está catalogada (BAS, 2000; YANG, 2000; TULLOSS, 2005; KIRK *et al*., 2008; ZHANG *et al*., 2015). Por sua vez, *Limacella*, tido como relíquia evolutiva, consta de apenas 20 espécies descritas (KIRK *et al*., 2008); TULLOSS & YANG (2016) listam um pouco mais de 50 nomes para o gênero e estimam a ocorrência de 60-100 espécies.

No Brasil, Amanitaceae vem sendo paulatinamente estudada e diversas publicações, abordando especialmente *Amanita*, têm sido divulgadas (GIACHINI *et al*., 2000, 2004; WARTCHOW & MAIA, 2007; MENOLLI *et al*., 2009a, 2009b; FERREIRA *et al*., 2013; WARTCHOW *et al*., 2007, 2009, 2013a, 2013b, 2015a, 2015b). Apesar disso, a família ainda permanece pouco conhecida, considerando a abrangência espacial e a diversidade de ecossistemas do território brasileiro. Ademais, análises moleculares não têm sido utilizadas na discriminação e posicionamento das espécies brasileiras, inviabilizando sua inclusão em estudos filogenéticos e filogeográficos abrangentes.

Na Lista de Espécies da Flora do Brasil (http://floradobrasil.jbrj.gov.br), atualmente sob responsabilidade do Jardim Botânico do Rio de Janeiro, são elencados 19 táxons (16 espécies; 2 variedades; 1 subespécie) de *Amanita* e uma única espécie de *Limacella*. Do total, apenas quatro representantes são mencionados para Nordeste brasileiro, especificamente para o estado de Pernambuco, com exceção de *Amanita viscidolutea* Menolli, Capelari & Baseia, cuja ocorrência abrange os estados da Paraíba e Rio Grande do Norte.

Visando contribuir para o conhecimento da diversidade de Amanitaceae no Brasil, o propósito deste trabalho foi efetuar o levantamento de espécies da referida família em áreas do Nordeste brasileiro, especialmente nos domínios de Caatinga e Mata Atlântica. O estudo foi realizado através da análise morfoanatômica de materiais provenientes de coletas, depositados em herbários e da coleção pessoal do Prof. Dr. Felipe Wartchow.

1.1 FUNDAMENTAÇÃO TEÓRICA

1.1.1 Amanitaceae

A família Amanitaceae R. Heim ex Pouzar, tipificada pelo gênero *Amanita* Pers, compreende, tradicionalmente, dois gêneros: *Amanita* e *Limacella* Earle (SINGER, 1986). Em sua proposta de classificação, Kirk *et al*. (2008) inclui o gênero *Catratama* Franco-Molano, tendo com base os resultados advindos das análises filogenéticas realizadas por Moncalvo *et al*. (2002). Recentemente, um novo gênero, denominado *Aspidella* E.-J. Gilbert foi seregado de *Amanita* por Vizzini *et al*. (2012); o epíteto escolhido para o novo gênero foi considerado ilegítimo e o nome *Saproamanita* foi proposto por Redhead *et al*. (2016) como substituto.

Na maior parte do mundo, a família Amanitaceae compreende espécies que apresentam basidioma agaricoide e estipe central. Entretanto, um pequeno número de formas gasteroides e secotioides têm sido registradas para a região mediterrânea e sudoeste da Austrália (Justo *et al*. 2010; Tulloss & Yang, 2016). Tais exceções foram inicialmente tratadas em dois gêneros (1) *Amarrendia* Bougher & T. Lebel e (2) *Torrendia* Bres, os quais atualmente são sinônimos de *Amanita* (JUSTO *et al*., 2010).

Segundo Singer (1986), as espécies de Amanitaceae são caracterizadas por apresentarem desenvolvimento bivelangiocárpico; hábito pluteoide; basidioma carnoso; lamelas livres ou sublivres, ventricosas a subventricosas, finas; lamélulas frequentemente truncadas; volva presente ou ausente, às vezes bem desenvolvida na base do estipe, mas em algumas espécies é reduzida a uma bainha mucilaginosa, ou ainda fragmentando-se em flocos, verrugas, escamas, fragmentos ou faixas no píleo e no estipe; véu parcial presente, raramente ausente, superior. Trama himenoforal bilateral na maturidade, regular ou bilateral no primórdio, com hifas do estrato lateral geralmente infladas/clavadas; trama do píleo/estipe monomítica, presença de acrofisálides, hifas inamiloides, com ou sem grampos de conexão; basídios clavados ou levemente alongados, bi os tetraesporados; cistídios ausentes; células vesiculosas geralmente aderidas à extremidade da lamela; esporos globosos a cilíndricos, maioria curto-elipisoides a subglobosos, lisos com parede fina e homogênea, raramente punctados, amiloides ou inamiloides, acianófilos e binucleados. Maioria terrestre ou humícola, ocorrendo principalmente em áreas de florestas, onde estabelecem associações ectomicorrízicas.

Ao considerar os avanços na área e na tentativa de organizar melhor a delimitação da família, Tulloss *et al*. (2016) apresentam uma caracterização funcional e atualizada para Amanitaceae (Tabela 01), uma vez que possibilita, objetivamente, testar a inclusão de determinado espécime de Agaricales na referida família. Com isso os autores pretendem diminuir o uso e a influência de caracterizações difusas e discordantes, as quais têm sido corriqueiras.

Tabela 1 - Caracterização da família Amanitaceae na forma de teste de inclusão.

<table>
<tr><td colspan="3"><i>Amanitaceae E.-J. Gilbert</i></td></tr>
<tr><td colspan="3">Caracterização: uma determinada espécie de Agaricales é membro de Amanitaceae se e somente se satisfizer uma das seguintes condições:</td></tr>
<tr><td>1. Basidioma agaricoide</td><td>2. Basidioma secotioide</td><td>3. Basidioma hipógeo*</td></tr>
<tr><td>↓
Trama do estipe é longitudinalmente acrofisalídica (Figura 01). Adicionalmente, como carácter suporte, presença de trama lamelar bilateral divergente.</td><td>↓
Trama do estipe é longitudinalmente acrofisalídica.</td><td>↓
É membro de uma lista determinada por análises moleculares e inclui apenas dois táxons: <i>A. grandispora</i> (G. W. BEATON et al.) Justo e <i>A. oleosa</i> (BOUGHER & T. LEBEL) Justo.</td></tr>
</table>

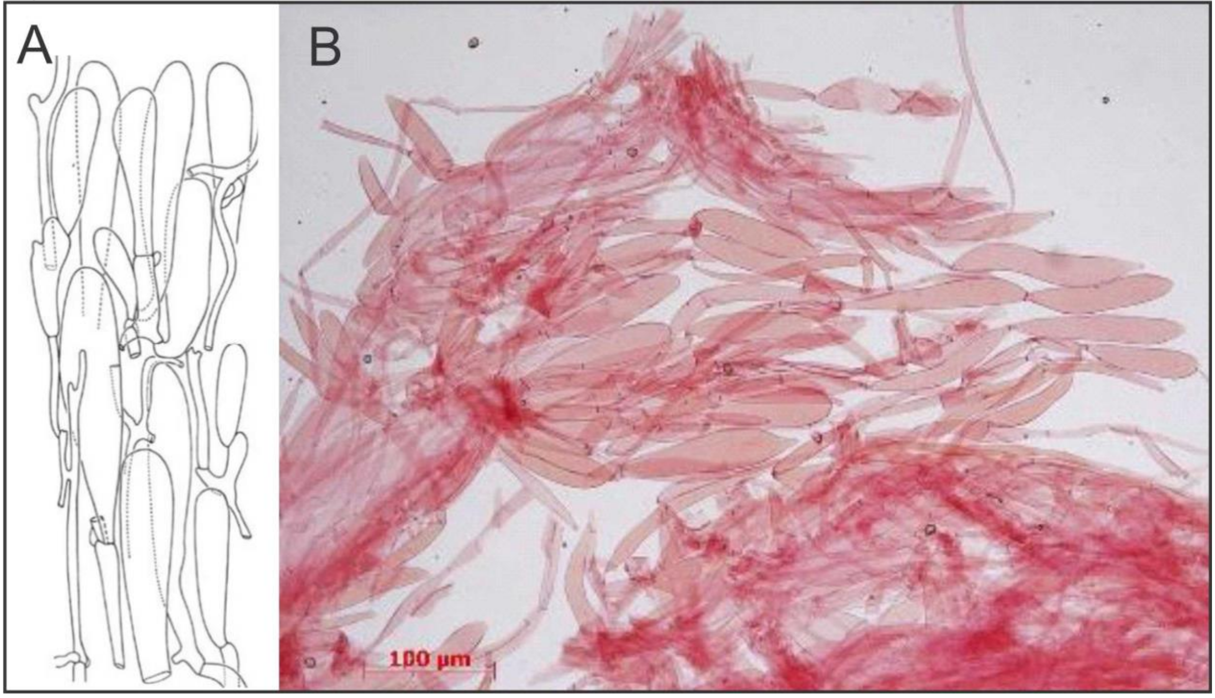
***** O suporte morfológico que justifique a ocorrência de espécies hipógeas em Amanitaceae ainda é controverso (JUSTO *et al*., 2010; TULLOSS *et al*., 2016).
Fonte: Informações adaptadas de Tulloss *et al*. (2016).

1.1.2 *Amanita*

1.1.2.1 Histórico da Classificação

O gênero *Amanita* foi estabelecido por Persoon, em1797, sendo segregado a partir de *Agaricus sensu* Lineu. O autor definiu o gênero pela presença marcante de uma volva, cuja consistência variava de membranosa a friável. Como consequência desta definição, algumas espécies de esporada rosada, atualmente circunscritas em *Volvariella* Speg., foram consideradas espécies de *Amanita*.

Figura 1 - Acrofisálides presentes na trama do estipe em *Amanita*. **A**. *Amanita timida*. **B**. *A. phalloides*.



Fonte: Adaptado de Bas (1969) e Tullos & Yang (2016).

Fries (1815, 1818) incialmente concebeu *Amanita* conforme sua concepção original. Contudo, em trabalho posterior (FRIES, 1821) o autor reduz *Amanita* a uma tribo de *Agaricus*, classificando as espécies em quatro grupos com base na morfologia/consistência da volva e também na presença ou ausência de estriações na margem pilear. Concomitantemente, o autor segrega as espécies de esporada rosa em uma tribo distinta, denominada *Volvaria*.

Várias tentativas de segregar gêneros a partir de *Amanita* foram realizadas ou apoiadas por diversos autores na primeira metade do Século XX, com base em evidências morfológicas e anatômicas (ex.: CLEMENTS & SHEAR, 1931; EARLE, 1909; GILBERT, 1925, 1940; GÜSSOW & ODELL, 1927; KONRAD & MAUBLANC 1924–37, 1930; MURRILL, 1914; SINGER, 1936; SMITH & GRUBER, 1949). No entanto, todos os gêneros segregados, exceto *Amanitopsis* Roze (GROVES, 1962), foram rejeitados e sinonimizados por autores na segunda metade do século e no início do seguinte (ex.: BAS, 1969; HORAK, 2005; ITO, 1959; KNUDSEN & VESTERHOLT, 2012; KÜHNER & ROMAGNESI, 1953; MOSER, 1983; SHAFFER, 1968; SINGER, 1951, 1962, 1975, 1986; SMITH *et al*., 1979). Por fim, *Amanitopsis*, para o qual foram transferidas todas as 'amanitas' exanuladas, foi sinonimizado e manteve-se, portanto, a integridade genérica de *Amanita*.

A partir do final da década de 90, com a utilização de dados moleculares em trabalhos de filogenia, a monofila de *Amanita* tem sido consistentemente suportada (WEIß *et al*., 1998; DREHMEL *et al*., 1999; MONCALVO, *et al*. 2000, 2002). No entanto, uma nova proposta de segregação do gênero surgiu recentemente apoiada em supostas evidências moleculares (VIZZINI *et al*., 2012). Essa proposta mais recente será abordada a seguir na subseção 2.2.4.

1.1.2.2 Classificação Infragenérica

Desde seu estabelecimento, diversas classificações infragenéricas baseadas na morfologia têm sido propostas para *Amanita* (ex.: GILBERT & KUEHNER, 1928; KONRAD & MAUBLANC, 1948; SINGER, 1951, 1986; CORNER & BAS, 1962; MOSER, 1967; BAS, 1969; YANG, 1997).

Conforme o delineamento taxonômico proposto por Corner & Bas (1962) e Bas (1969), o gênero *Amanita* pode ser dividido em dois subgêneros com base na reação de amiloidia dos basidiósporos em reagente de Melzer, embora outras características sejam também consideradas nessa distinção, tais como, magem do pílio e forma das lamelas. Nesse arranjo, as espécies com esporos amiloides estão classificadas no subgênero *Lepidella* (E.-J. Gilbert) Veselý, sendo o mesmo subdividido em quatro seções: (1) *Amidella* (E.-J. Gilbert) Veselý, (2) *Lepidella* E.-J. Gilbert, (3) *Phalloideae* (Fr.) Quél. e (4) *Validae* (Fr.) Quél (Tabela 02).

Por sua vez, o subgênero *Amanita* inclui as espécies que apresentam basidiósporos inamiloides. Para o arranjo sistemático deste subgênero, Corner & Bas (1962) e Bas (1969) alocaram todas as espécies com a base do estipe bulbosa em *Amanita* seção *Amanita,* enquanto aquelas sem um bulbo basal foram classificadas em *Amanita* seção *Vaginatae* (Fr.) Quél. Posteriormente, Yang (1997, 2005) tratou seção *Vaginatae* s.l. [*sensu* CORNER & BAS (1962) e BAS (1969)] como duas seções distintas: (1) *Vaginatae* s.s. e (2) *Caesareae* Singer ex Singer. Espécies que apresentavam anel membranoso e grampos de conexão na base dos basídios foram arranjadas na seção *Caesareae*, e aquelas que não possuíam nem anel e nem basídios com ansas basais foram dispostas na seção *Vaginatae* s.s. (YANG, 1997, 2005).

Outro esquema infragenérico digno de nota refere-se ao de Singer (1986). Utilizando os mesmos critérios da classificação de Corner & Bars (1962) e Bas (1969), Singer (1986) subdivide *Amanita* em dois subgêneros, mas circunscreve um número maior de seções em cada um. Assim, o subgênero *Amanita* compreende as seções (1) *Amanita*, (2) *Caesareae,* (3) *Ovigerae* Singer e (4) *Vaginatae,* e o subgênero *Lepidella* as seções (1) *Amidellae* (E.-J. Gilbert) Konr. e Maubl., (2) *Mappae* E.-J. Gilbert, (3) *Phalloideae,* (4) *Roanokenses* Singer e (5) *Validae*.

Tabela 2 - Seções de *Amanita* de acordo com Corner & Bas (1962) e Bas (1969), com atualizações propostas por Yang (1997) e Tullos & Yang (2016).

Seções	**Características Morfo/Anatômicas**	**Tipo (Fig. 02)**
	Subgênero *Lepidella* (Basidiósporos amiloides)	
Amidella	• Margem pilear apendiculada como descrito também para seção *Lepidella*, porém com material pendente mais escasso e evanescente (desaparecendo rapidamente a medida que o basidima amadurece); • Na maioria das espécies, durante o desenvolvimento, o estipe sofre alongado em toda sua extensão; • Volva (véu universal) sacada, formando um saco membranoso na base do estipe; às vezes a camada mais interna da volva é bastante frágil (friável), formando escamas, fragmentos ou material pulverulento no píleo; • Apenas uma espécie da seção possui véu parcial (observado apenas em estágios iniciais da expansão do basidioma).	*A. volvata*
Lepidella	• Margem pilear distintamente apendiculada (decorada com material mais ou menos flocoso ou pulverulento), pelo menos inicialmente; • Volva sacada nunca presente.	*A. vittadinii*
Phalloideae	• Margem pilear não apendiculada; • Estipe sempre apresentando uma base bulbosa; • Véu parcial persistente; • Véu universal sempre membranoso; e presente na base do estipe formando uma volva limbada ou sacada.	*A. phalloides*
Validae	• Margem do píleo nunca apendiculada; • Véu parcial persistente; • Estipe sempre apresentando uma base bulbosa, porém o diâmetro do bulbo pode reduzir com a idade; • Véu universal sempre friável (frágil, quebradiço), inteiramente ou parcialmente.	*A. excelsa*
	Subgênero *Amanita* (Basidiósporos inamiloides)	
Amanita	• No primórdio: basidioma se desenvolve excentricamente (Superior); • Como consequência da ontogenia, o basidioma maduro apesenta frequentemente um bulbo na base do estipe; embora, esta característica não possa ser facilmente observada nos basidiomas adultos de algumas espécies.	*A. muscaria*
Caesareae	• No primórdio: o basidioma se desenvolve aproximadamente na porção central; • Durante a ontogenia o estipe sofre alongado em toda sua extensão. Como consequência, o basidioma maduro não apresenta um bulbo basal; • Presença de véu parcial**; • Véu universal (volva): formando uma estrutura sacada na base do estipe; • Presença de grampos de conexão na base dos basídios**; • A superfície do estipe de muitas espécies desta seção possui uma forma única de ornamentação, a qual é formada por remanescentes do '*limbus internus*' do véu universal.	*A. caesarea*

Vaginatae	• A ontogenia é semelhante a que ocorre na seção *Caesareae* (acima); • Véu parcial ausente**; • Véu universal (volva): usualmente sacado***; • Grampos de conexão usualmente ausentes na base dos basídios**.	*A. vaginata*

** Tang *et al*. (2015) examinaram espécies de *Amanita* da África tropical posicionadas na seção *Vaginatae* [sensu CORNER & BAS (1962); BAS (1969)] e que apresentavam anel, porém grampos de conexão ausentes. As análises filogenéticas realizadas indicaram o posicionamento sistemático dessas espécies na seção *Vaginatae* s.s. (YANG, 1997). Nesse contexto, baseados também em constatações semelhantes em estudos para Bangladesh e China (dados ainda não publicados), os referidos autores indicaram que espécies anuladas pertencentes a seção *Vaginatae* s.s. parecem estar amplamente distribuídas nas regiões tropicais. Por fim, eles sugerem uma pequena modificação na seção *Vaginatae* s.s, a qual passaria a incluir também espécies tropicais anuladas.

*** A estrutura volval sacada pode apresentar uma camada interna bastante frágil, o que pode ocasionar o rompimento ou a fragmentação da estrutura como todo, resultando em uma grande variedade de tipos estruturais nas diferentes espécies (TULLOSS & YANG, 2016).

Fonte: Informações adaptadas de Corner & Bas (1962), Bas (1969), Yang (1997) e Tullos & Yang (2016).

Desde as primeiras topologias baseadas em nLSU (WEIß *et al*., 1998; DREHMEL *et al*., 1999) e ITS (ODDA *et al*., 1999), análises de DNA em trabalhos de filogenia têm contribuído para reexaminação das classificações tradicionais de *Amanita* (ZHANG *et al*., 2004; JUSTO *et al*., 2010; WOLFE *et al*. 2012; CAI et al. 2014). Nesse contexto, a segregação em dois subgêneros, *Amanita* e *Lepidellla*, tem sido ratificada, em correspondência a amiloidia dos esporos e outras características morfo/anatômicas.

Ao nível seccional, a divisão sistemática de Corner & Bas (1962) e Bas (1969), levemente modificada por Yang (1997), é considerada a mais natural (Tabela 02), uma vez que a origem monofilética de todas as seções propostas, com exceção da seção *Lepidella*, tem sido confirmada em diversos estudos filogenéticos.

1.1.2.3 Recente Proposta de Divisão do Gênero *Amanita*

Recentemente, o até então bem estabelecido gênero *Amanita* foi dividido em dois táxons monofiléticos: (1) *Amanita*, compreendendo os representantes ectomicorrízicos e (2) *Aspidella* E.-J. Gilber, reunindo as espécies saprotróficas. O epíteto *"Aspidella*", no entanto, mostrou-se ilegítimo e o nome *Saproamanita* foi proposto por Redhead *et al*. (2016) como substitutivo.

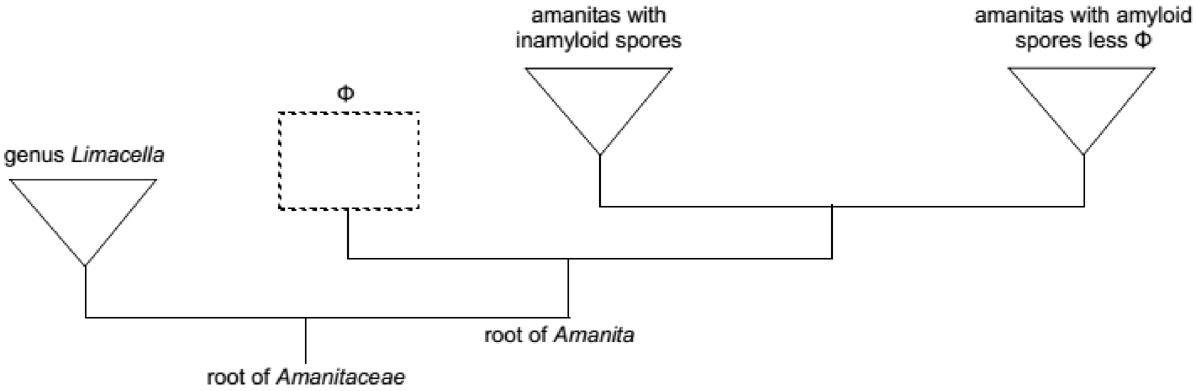
O gênero *Amanita*, desde os primeiros estudos filogenéticos baseados em dados moleculares, tem sido consistentemente suportado com grupo monofilético, possuindo vários agrupamentos subgenéricos bem definidos e ocupando posição de grupo irmão de *Limacella* (WEIß *et al*., 1998; DREHMEL *et al*., 1999; MONCALVO, *et al*. 2000). Posteriormente, Wolfe *et al*. (2012) propõem uma hipótese filogenética construída a partir de uma amostragem robusta, com ênfase na inclusão de espécies de *Amanita* secção *Lepidella* sensu Bas (1969). Os resultados apresentados na análise confirmam, com elevado suporte, o posicionamento de *Amanita* e *Limacella* como clados irmãos. Além disso, um terceiro "clado" (ou elemento) contendo amanitas assinbióticas ocupou uma posição basal em relação aos dois grandes clados que representam o gênero *Amanita* (Figura 3).

Figura 2 - Representantes das espécies tipo das seções de *Amanita*. A. *A. muscaria*. B. *A. caesarea*. C. *A. excelsa*. D. *A. phalloides*. E. *A. vaginata*. F. *A. volvata*. G. *A. vittadinii*.

Fonte: Fotos disponíveis em Tulloss & Yang (2016).

Em seguida, Vizzini *et al*. (2012), baseados nas publicações e nos dados fornecidos por Wolf *et al*. (2012a, 2012b), propõem a segregação do gênero *Amanita* em dois táxons monofiléticos: (1) *Amanita*, compreendendo os representantes ectomicorrízicos e (2) *Aspidella*, reunindo as espécies saprotróficas. O epíteto "*Aspidella*". No entanto, mostrou-se ilegítimo e *Saproamanita* foi proposto por Redhead *et al*. (2016) como substitutivo. Em contrapartida, Tulloss *et al*. (2016) opuseram-se veementemente à separação do gênero com base nas seguintes argumentações:

Figura 3 - Versão esquemática da extensa filogenia apresentada em Wolf *et al*. (2012b).



Fonte: Adaptado de Tulloss *et al*. (2016).

(1) Vizzini *et al*. (2012)/Redhead *et al*. (2016) não seguiram estritamente as diretrizes propostas por Vellinga *et al*. (2015) para proposição de um novo gênero.

(2) Vizzini *et al*. (2012) erroneamente consideram o "clado" assimbiótico Φ (Figura 3) equivalente a *Amanita* subseção *Vittadiniae* Bas (BAS, 1969). Com base na hipótese de Wolf *et al*. (2012b) a referida subseção pode ser considerada parafilética, uma vez que o "stirps" *Hesleri* não tem suporte dentro de Φ.

(3) A interpretação equivocada de que a filogenia apresentada por Wolf *et al*. (2012b) forneceu evidências suficientes para segregar espécies ectomicorízicas e saprotróficas dentro de *Amanita*. Em tese, o elemento Φ (Figura 3) inclui apenas um táxon definitivamente sapróbio [*A. thiersii* (BAS, 1969; WOLFE *et al*., 2012a.; TULLOSS & YANG, 2016)]. As modalidades tróficas dos outros táxons ainda não foram estudadas em detalhes.

Por fim, após refutar a separação do gênero *Amanita*, Tulloss *et al*. (2016) propõem apenas uma pequena modificação sistemática, a qual inclui a remoção da "stirps" *Hesleri* da subseção *Vittadiniae*.

1.1.2.4 Gasteromicetização

O agrupamento de táxons de gasteromicetos entre vários grupos de homobasidiomicetos tem sido evidencido em diversos trabalhos pioneiros (e.g; BRUNS *et al*., 1989; BAURA *et al*., 1992; KRETZER & BRUNS, 1997; HIBBETT *et al*., 1997; PEINTNER *et al*., 2001), indicando, desta forma, que o processo de gasteromicetização evoluiu independentemente repetida vezes em diversos grupos de fungos agaricoides/boletoides (HIBBETT, 2007).

O gênero secotioide *Torrendia* e o gasteroide *Amarrendia* foram postulados como representantes próximos das amanitas agaricoides desde meados do Século XX (MALENCON, 1955; BAS, 1975). Esta hipótese foi posteriormente confirmada por meio da utilização de dados moleculares no trabalho de filogenia de Moncalvo *et al*. (2002). Em 2010, Justo *et al*. (2010) formalmente transferiram membros de *Torrendia* e *Amarrendia* para o gênero *Amanita*. Em adição, eles sugeriram que o clima mediterrânico houvera sido o responsável pela evolução convergente destes fungos sequestrados.

Recentemente, Truong *et al*. (2017) descreveram pela primeira vez uma espécie sequestrada (hipógea) de *Amanita* para o continente americano, associada com *Nothofagus antarctica,* no norte da Patagônia. Além disso, com base em análises filogenéticas multigene, a nova espécie foi posicionada no clado das amanitas temperadas do hemisfério sul (Figura 04), estando geneticamente relacionada com outros táxons sequestrados que ocorrem na Austrália. Estes resultados corroboram com o rastreamento de uma conexão relativamente antiga entre o sul da América do Sul e a Austrália ("*Gondwanan connection*"), a qual tem sido observada para outros poucos grupos de fungos ectomicorrízicos.

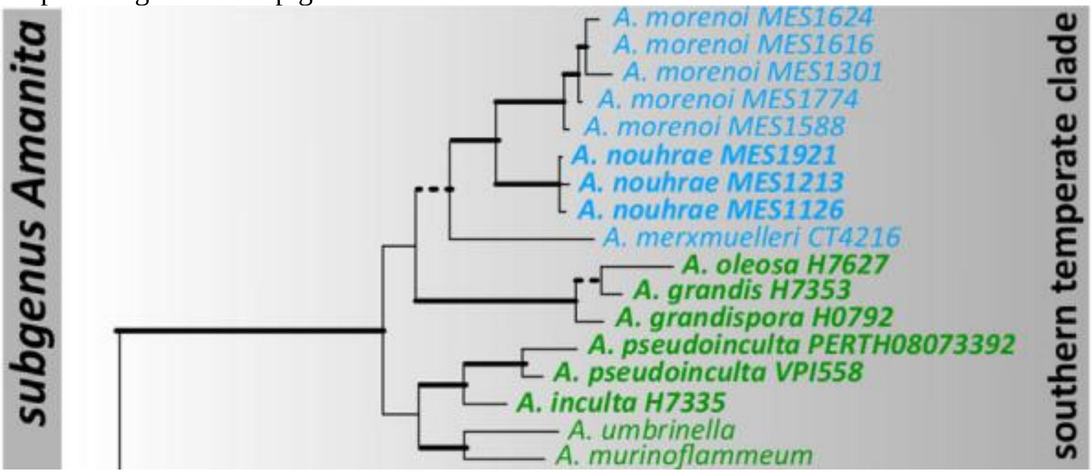
1.1.2.5 *Amanita* no Brasil

O registro mais antigo do gênero *Amanita* no Brasil foi feito por Rick (1906), que descreve *A. spissa* Fr. var. *laeta* Rick para o Rio Grande do Sul. Posteriormente, o autor cita *A. bresadolae* (Rick) Ricknon Schulzer para o mesmo Estado (Rick 1937), numa tentativa de renomear *Armillaria bresadolae* Rick (1907). No mesmo trabalho ele cita novamente *A. spissa* e, além desta espécie, *A. strobiliformis* Vitt. e *Amanitopsis plumbea* Rick. Todas essas espécies foram reunidas em uma obra póstuma, organizada e publicada pelo Padre Balduíno Rambo (RICK, 1961). Spegazzini (1919) citou *Armillaria ameghinoi* Speg. para o estado de São Paulo a partir de material coletado por Puiggari. Ao revisar os tipos de Spegazzini, Singer (1952) transferiu a espécie para o gênero *Amanita*, baseado em coletas feitas na Argentina e Uruguai, sem mencionar o material brasileiro.

Durante a revisão das espécies descritas pelo Padre Rick depositadas no Herbário do Instituto Anchietano (PACA), em São Leopoldo, RS, Singer (1953) revisou *A. bresadolae* e observou que o material tem características do gênero *Lepiota* Pers. O nome *L. crassior* foi proposto para este fungo, pois o epíteto "*bresadolae*" havia sido anteriormente publicado por

Hennings, em 1880, e Schulzer, em 1885. Hoje, sabe-se que a espécie descrita por Hennings corresponde a *Leucoagaricus americanus* (Peck) Vellinga (VELLINGA, 2000). Singer (1953) revisou *Amanitopsis plumbea*, mas não chegou a nenhuma conclusão sobre a real identidade da espécie. Outro tipo que chamou a sua atenção foi *Collybia sulcatissima* Rick, publicado por Rick (1938), um material em péssimas condições, suspeitando que seja conspecífica de *Amanitopsis plumbea*. No final de sua revisão, Singer (1953) fez uma lista de espécies de Agaricales confirmadas para o Rio Grande do Sul, e citou apenas uma espécie não identificada de *Amanita* para este estado.

Figura 4 - A espécie nova *A. nouhrae* agrupa-se com outras espécies sequestradas da Austrália formando um clado bem sustentado dentro do subgênero *Amanita*, e cuja composição inclui espécies sequestradas e também espécies agaricoides epígeas.



Fonte: Retirado de Truong *at al*. (2017).

Após os trabalhos de Rick (1906, 1907, 1937, 1938, 1961), Homrich (1965) cita *A. muscaria* para áreas de bosques de *Pinus* em várias cidades do planalto riograndense.

Em sua monografia, Bas (1969) observou que Singer (1953) não listou *A. spissa* var. *laeta*, concluindo que o tipo provavelmente não existe. Ao basear-se no curto protólogo de Rick (1906), Bas (1969) suspeitou que este fungo seja conspecífico a *A. singeri* Bas.

Na década de 70, Bas (1978) recebeu exsicatas coletadas por Singer em Manaus, Amazonas, e descreveu sete novas espécies (*A. campinaranae* Bas, *A. coacta* Bas, *A. craseoderma* Bas, *A. crebresulcata* Bas, *A. lanivolva* Bas, *A. sulcatissima* Bas e *A. xerocybe* Bas) e *A. phaea* Bas nom. prov., não descrito pela ausência de basidiosporos no material examinado. Estas espécies foram coletadas em floresta primária (*A. craseoderma*), floresta secundária (*A. coacta*, *A. crebresulcata*, *A. lanivolva* e *A. phaea*), vegetação de campinarana (*A. campinaranae*) e campina (*A. sulcatissima*). Neste estudo, Bas (1978) recebeu exsicatas de duas espécies descritas por Rick e observou que *Amanitopsis plumbea* tinha características que lembravam *A. coacta* e *A. crebresulcata*, enquanto *Collybia sulcatissima* apresentava características de *A. sulcatissima* e *A. xerocybe*. Contudo, pelo péssimo estado de conservação de ambas, Bas (1978) preferiu desconsiderá-las e descrever novas espécies a partir de coletas feitas na Amazônia.

Nos anos 80, poucas espécies de *Amanita* foram coletadas e citadas para o Brasil. Apenas Guerrero & Homrich (1983) citaram para Rio Grande do Sul *A. muscaria*. Grandi *et al*. (1984) citaram *A*. sp. aff. *crebresulcata* para São Paulo e Singer & Aguiar (1986) citaram três espécies de *Amanita* para o Amazonas, sem nomeá-las, sugerindo que eram espécies não anteriormente descritas. Logo depois, Capelari & Maziero (1988) elaboraram uma lista de fungos macroscópicos para Rondônia, e citaram *A. craseoderma* para este estado.

Na década de 90, Bas & Meijer (1993) descreveram *A. grallipes*, uma interessante espécie da subseção *Vittadiniae* coletada em floresta mista com *Araucaria angustifolia*, no estado do Paraná, a qual os autores suspeitam não formar associação ectomicorrízica. Bas & Meijer (1993) sugeriram que *A. grallipes* represente o táxon descrito como *A. spissa* var. *laeta* (RICK, 1906), mas com base em estudos anteriores (SINGER, 1953; BAS, 1969) decidiram descrever um novo táxon a partir de novas coletas. Este fungo cresce geralmente com um número grande de basidiomas, formado um "anel de fadas" (MEIJER, 2001).

Pegler (1997) revisou as Agaricales de São Paulo, confirmando a ocorrência de *A. crebresulcata* e *A. ameghinoi* neste estado, citados por Spegazzini (1919) e Grandi *et al*. (1984).

Giachini *et al*. (2000) realizam um levantamento de fungos ectomicorrízicos em plantações exóticas de *Eucalyptus* e *Pinus* para o estado de Santa Catarina e citam *A. muscaria* e *A. pantherina* (Dc.: Fr.) Krombh. var. *multisquamosa* (Peck) Dav. T. Jenkins, que na verdade corresponde à *A. multiscamosa* Peck (JENKINS, 1978). Posteriormente, Giachini *et al*. (2004) afirmam que estas espécies formam basidiomas preferencialmente no outono.

No sul do Brasil, Sobestiansky (2005) referiu macromicetos nos estados do Rio Grande do Sul e Santa Catarina, citando pela primeira vez para o país *A. rubescens* Pers.: Fr. e referindo novamente *A. muscaria* para o Rio Grande do Sul, ambas encontradas próximas a árvores introduzidas. No Paraná, de Meijer (2006) listou 1113 espécies de basidiomicetos, entre as quais *A. chrysoleuca* Pegler, *A*. cf. *crebresulcata*, *A. grallipes* e *A. muscaria*. Em São Paulo, Menolli *et al*. (2009a) fizeram a redescrição de *A. coacta* embasados na análise de diversas coleções feitas para o estado.

Wartchow *et al*. (2013a) descreveram *A. petalinivolva* para o estado do Rio Grande do Sul. No mesmo ano, Wartchow *et al*. (2013b) realizaram o estudo infraespecífico de *A. muscaria* a partir de matérias coletados no sul do Brasil e coleções depositadas em herbários, concluindo pela existência de duas subespécies: *A. muscaria* subespécie *muscaria* (L.) Lam. e *A. muscaria* subespécie *flavivolvata* Singer. Wartchow *et al*. (2015a) registraram *A. aureoflocosa* Bas pela primeira vez no Brasil, em seguida Wartchow (2015) descreveu uma nova espécie denominada *A. tenacipulvis* Wartchow, coletada em região de campinarana na Amazônia. Por último, Wartchow & Cortez (2016) descreveram uma nova “amanita” associada a *Eucalyptus* para o sul do país: *A. alinea* Wartchow & Cortez.

No nordeste brasileiro, trabalhos referentes à *Amanita* são escassos e até o início deste século apenas *Amanitopsis regalis* (Berk.) Sacc tinha sido registrada (MAIA *et al*., 2002). A partir da segunda metade da última década, o gênero *Amanita* começou a ganhar mais atenção nesta região do país, e Wartchow *et al*. (2007b, 2009) citaram pela primeira vez para o Brasil *Amanita lilloi* Singer (subseção *Vittadiniae)*, e descreveram *A. lippiae* Wartchow & Tulloss, uma interessante espécie descoberta no semiárido brasileiro. Wartchow & Maia (2007) referiram a ocorrência da espécie amazônica *A. crebresulcata* em área de Mata Atlântica. Menolli *et al*. (2009b) descrevem *A. viscidolutea* para área de dunas no Rio Grande do Norte; a mesma teve seu tipo revisado posteriormente por Wartchow *et al*. (2013a). Recentemente, Wartchow *et al*. (2015b) e Wartchow (2016) descreveram respectivamente *A. psammolimbata*, primeiro representante de *Amanita* seção *Phalloideae* referido para o Brasil, e *A. viridissima* Watchow, uma espécie com coloração verde, bastante peculiar, coletada em região de floresta nebular na Chapada da Diamantina (BA).

1.1.3 *Limacella*

Aparentemente considerado uma relíquia evolutiva, o gênero *Limacella* representa um grupo incomum e de difícil interpretação, ocorrendo provavelmente em escala mundial, exceto em regiões polares e arredores (Tulloss & Yang, 2016). Entretanto, apesar da presumível amplitude de ocorrência, a maioria das espécies foram descritas apenas para Europa e América do Norte, com registros escassos ou mesmo inexistentes para regiões como a Austrália e América do Sul (NEVILLE & POUMARAT, 2004; TULLOSS & YANG, 2016). Segundo Kirk *et al*. (2008), o referido gênero compreende cerca de 20 espécies, enquanto Tulloss & Yang (2016) listam mais de 57 nomes (incluindo alguns sinônimos) e estimam que 60-100 espécies ocorram especialmente ao longo de ecossistemas tropicais e subtropicais.

Morfologicamente**,** segundo Singer (1986), o gênero *Limacella* pode ser reconhecido pela seguinte combinação de caracteres: píleo mais ou menos víscido, sem fragmentos/remanescentes da volva; lamelas livres ou sub-livres; lamellulas não truncadas;

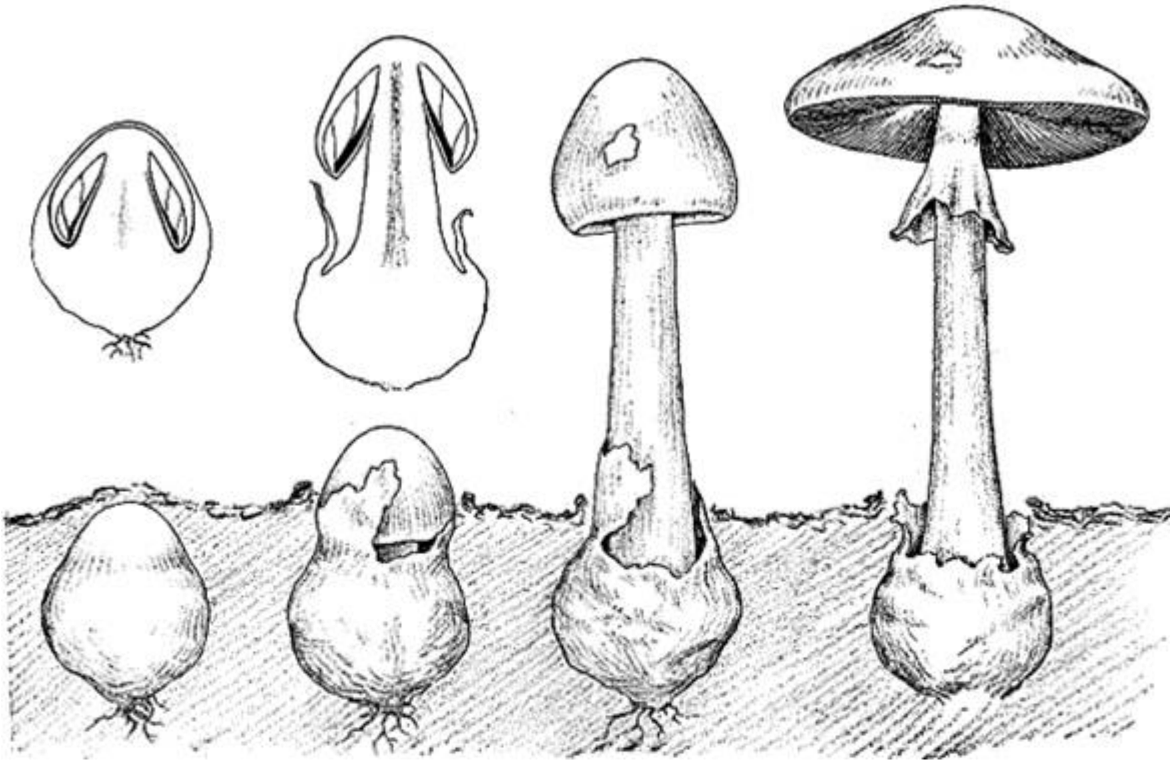
esporada branca; esporos pequenos, raramente medianos em tamanho, lisos ou finamente rugosos a punctados, hialinos, com parede homogênea, ovoides ou curto-elipsoides, ou então elipsoides a subglobosos ou globosos, inamiloides, às vezes aparentemente dextrinoides, acianófilos; basídios normais; elementos cistidiais ausentes; basidíolos abortados (pseudoparáfises) frequentemente observados na extremidade das lamelas; subhimêmio celular, trama himenoforal distintamente bilateral quando jovem, posteriormente tornando-se mais ou menos irregular ou entrelaçada/emaranhada; estipe seco ou víscido, sempre central; véu parcial glutinoso, ou então formando um anel carnoso ou membranoso, às vezes cortinoide; volva ausente ou inteiramente viscosa/glutinosa, nunca membranosa ou pulverulenta; contexto carnoso, formado por hifas inamiloides; grampos de conexão comuns em todos os tecidos.

Ainda que usual na distinção morfológica em relação ao gênero *Amanita*, a caracterização de Singer (1986) carece de precisão e clareza na abordagem de caracteres chaves para delimitação de *Limacella*.

Segundo Tulloss & Yang (2016) e Tulloss *et al.* (2016), o gênero *Limacella* pode ser inequivocamente diferenciado de *Amanita* pelo modo de desenvolvimento do basidioma (ontogenia). Enquanto as espécies de *Amanita* compartilham um processo ontogênico esquizomenial (Figura 05), aquelas em *Limacella* apresentam, de maneira geral, um tipo de desenvolvimento comum aos outros Agaricales de solo. Assim sendo, as lamelas em *Limacella* crescem em uma cavidade formada sob a superfície inferior do píleo em desenvolvimento. Por conseguinte, as extremidades das lamelas apresentam-se férteis, o que contrasta com a borda lamelar não-fértil de *Amanita*, visto que a extremidade das lamelas desenvolvem-se aderidas ao véu parcial ou à superfície do estipe.

Outra característica importante na definição de *Limacella* refere-se a presença de uma matriz glutinosa na superfície pilear (TULLOSS *et al.*, 2016). Tal caractere tem sido bastante enfatizado por diversos autores (KOMOROWSKA, 1984; SINGER, 1986; RIDLEY, 1993; GMINDER, 1994; NEVILLE & POUMARAT, 2004), embora poucos tenham explorado sua relevância taxonômica e evolutiva. De acordo com Raijnders (1979), a formação da camada de glúten em *Limacella* corre em pelo menos duas etapas durante ontogenia pilear. Primeiramente, a partir da camada mais externa do píleo ocorre o crescimento vertical de hifas delgadas, as quais tornam-se gelatinizadas, e então colapsam formando uma capa viscosa na superfície. Posteriormente, um segundo conjunto de hifas, advindas do tecido subjacente, penetram verticalmente na matriz glutinosa, reforçando sua estrutura. Tullos & Yang (2016) enfatizam que este conjunto hifas não cresce a partir de uma pilleipellis (cutícula), mas de uma camada densa de hifas localizada na porção mais distal do contexto pilear. Nessa perspectiva, a menção de uma “pileipellis” em diversos manuscritos refere-se ao glúten e às hifas verticalmente associadas, os quais formam uma camada análoga ao véu universal em *Amanita*. Curiosamente, a ausência de pileipellis também é uma condição observada na maioria das espécies de *Amanita* subseção *Vittadiniae* (seção *Lepidella*) (BAS, 1969).

Figura 5 - Ontogenia esquizohimeal que ocorre em *Amanita*.



Fonte: Ilustração disponível em Tulloss & Yang (2016).

Por fim, os discernimentos supracitados acerca da ontogenia de *Limacella* levaram Tulloss *et al*. (2016) a postular a seguinte condição de inclusão: as espécies de Amanitaceae são membros do gênero *Limacella* se e somente se possuírem (1) hábito agaricoide não produzido por processo ontogênico esquizomenial, (2) borda da lamella fértil e (3) matrix glutinosa sustentada por hifas compactadas e anticlinalmente orientadas.

1.1.3.1 Classificação Infragenérica

A circunscrição de *Limacella* é incerta, especialmente devido a inexistência de estudos que visassem a revisão de uma parcela significante das espécies descritas. Assim, muitos caracteres são interpretados de maneira vaga ou errônea por diferentes autores; outros são baseados provavelmente em interpretação equivocada da ontogenia dos tecidos e correlações de analogia entre os tecidos de *Limacella* e *Amanita*.

A classificação infragenética proposta por Singer (1986) divide *Limacella* em duas seções com base na viscosidade do estipe: seção *Lubricae* e seção *Limacella* [= *Viscidae* (SMITH, 1945)]. Seção *Lubricae* inclui táxons com um estipe víscido ou glutinoso, enquanto aqueles em seção *Limacella* possuem um estipe seco. Posteriormente, estudando caracteres morfológicos e ecológicos das espécies europeias de *Limacella*, Gminder (1994) descreveu uma nova seção (*Amanitellae*) para acomodar *L. guttata* (Pers.) Konrad & Maubl e táxons relacionados (Tabela 03).

Tabela 3 - Seções de *Limacella* de acordo com Gminder (1994) e Tulloss & Yang (2016).

Seções	**Características Morfo/Anatômicas**	**Tipo**
Amanitellae	• Estipe seco ou não-víscido/glutinoso (pelo menos em parte); • Células terminais das hifas de suporte de glúten em forma cônica ou subcônica; tais células frequentemente possuindo uma ou mais células subjacentes, as quais são distintamente infladas (globosa, subglobosa, largamente elipsoide, etc.).	***L. guttata***
Limacella	• Estipe seco ou não-víscido/glutinoso (pelo menos em parte); • Células terminais das hifas de sustentação do glúten não cônicas e nunca surgindo a partir de hifas com células intercalares infladas; • A razão do comprimento pela largura máxima de tais células terminais é < 20.	***L. furnacea***
Lubricae	• Estipe completamente víscido ou glutinoso abaixo do véu parcial; • Células terminais das hifas de sustentação do glúten não cônicas e nunca surgindo a partir de hifas com células intercalares infladas; • A razão do comprimento pela largura máxima de tais células terminais é ≥ 20.	***L. illinita***

Fonte: Informações adaptadas de Gminder (1994) e Tulloss & Yang (2016).

1.1.3.2 *Limacella* no Brasil

Quatro espécies de *Limacella* já foram registradas para o território brasileiro. Três destas (*L. illinita* (Fr.) Maire, *L. glischra* (Morgan) Murrill e *L. guttata*) foram citadas apenas em *checklists* de Agaricales (BONONI, 1984; PEGLER, 1997; MEIJER, 2006), sem comentários sobre macro e microcaracteres ou menção do tombamento em herbário, impossibilitando, desta forma, a confirmação dos registros. Assim, a única espécie que provavelmente ocorre no Brasil é *L. ochraceolutea*, crescendo em solo de floresta entre folhas caídas de *Syagrus romanzoffianum* (Cham.) Glassman (palmeira) no estado do Paraná, sul do Brasil (FERREIRA *et al*., 2013). Esta representa a única espécie de *Limacella* para América Central e do Sul que apresenta uma descrição completa e que segue as recomendações modernas para o estudo de Amanitaceae introduzidas desde os estudos pioneiros de Corner & Bas (1962) e Bas (1969).

1.1.4 *Catatrama*

O gênero *Catatrama* Franco-Mol. foi estabelecido para acomodar uma única espécie, *C. costaricensis* Franco-Mol., um agárico bastante distinto de hábito lepiotoide e esporada branca, coletado no sul da Costa Rica. A referida espécie pode ser reconhecida pela seguinte combinação de caracteres: basidiósporos equinulados, cianófilos e inamiloides; lamelas sublivres; trama himenoforal bilateral divergente (FRANCO-MOLANO, 1991).

O gênero foi originalmente descrito na família *Tricholomataceae* (FRANCO-MOLANO, 1991), estando intimamente relacionado com *Rhodotus* Maire devido: (1) presença de grampos de conexão, (2) esporos equinulados, (3) trama himenoforal bilateral e (4) ausência de cistídios. Apesar disso, Franco-Molano (1991) ressaltou que *Catratama* também compartilha algumas características morfoanatômicas com Agaricaceae (esporada branca, esporos inamiloides, equinulados, cianófilos e sem poro germinativo) e Amanitaceae (lamelas sublivres, trama himenoforal bilateral).

Em tratamento sistemático filogenético abrangente, Moncalvo *et al*. (2002) demonstraram o agrupamento de *Catatrama* e *Limacella* em um mesmo clado dentro de *Amanitaceae*. Os autores elencaram trama lamelar bilateral, píleo víscido e esporos amiloides como caracteres de suporte morfológico do clado, no entanto, estes dois últimos caracteres não constam originalmente na descrição de Franco-Molano (1991) e, portanto, foram erroneamente atribuídos, como já apontado por Wartchow *et al*. (2007a).

Atualmente, Kirk *et al.* (2008) aceitam o gênero monoespecífico *Catatrama* como pertencente à família *Amanitaceae*, embora fracamente suportado com base na morfologia. Isso se deve ao fato de *C. costaricensis* não possuir acrofisálides, que são estruturas clavadas e terminais localizadas em uma trama de hifas longitudinais no estipe (BAS, 1969). Em trabalho recente, Tulloss *et al*. (2016) reiteraram a presença de acrofisálides como um caractere diagnóstico de Amanitaceae.

Quanto ao hábitat, *C. costaricensis* foi originalmente referida crescendo em solo de floresta de *Quercus pilaris* Trel., na Costa Rica. Posteriormente, Vrinda *et al*. (2000) registraram uma nova ocorrência da espécie para área de bosques sagrados em Kerala (Índia), também crescendo em solo, no entanto, os autores não se referem a dados sobre a vegetação associada. No Brasil, Wartchow *et al*. (2007a) registraram pela primeira vez hábito lignícola para a espécie, cuja coleta ocorreu em um fragmento de Mata Atlântica no estado de Pernambuco. Além disso, o espécime brasileiro apresentou tamanho bem pequeno e a presença de poucas escamas na superfície do estipe.

1.2 OBJETIVOS

1.2.1 Geral

- Contribuir para o conhecimento de *Amanitaceae* em áreas do nordeste brasileiro, com ênfase nos estudos morfoanatômicos no tratamento taxonômico das espécies.

1.2.2 Específicos

- Inventariar a família em áreas pontuais do nordeste brasileiro, com ênfase no semiárido e em remanescentes de Mata Atlântica;
- Identificar, descrever e ilustrar os espécimes coletados;
- Realizar estudos comparativos com material procedente de coleções de herbários;
- Elaborar chave de identificação de *Amanita* (por seção) para o Brasil;
- Elaborar *checklist* de Amanitaceae para a América do Sul;

1.3 MATERIAL E MÉTODOS

1.3.1 Áreas de estudo

Incursões para o inventário de espécies foram realizadas principalmente em áreas do semiárido e em remanescentes de Mata Atlântica. A tabela abaixo elenca as áreas visitadas (Tabela 04).

Tabela 4 - Áreas de coleta e indicação do respectivo estado.

ÁREAS DE COLETA	ESTADO
APA Delta do Parnaíba (áreas do município de Ilha Grande) (ADP)	PI
Campus I da Universidade Federal da Paraíba (Fragmentos/Mata Atlântica) (UFPB)	PB
Floresta Nacional da Restinga de Cabedelo (Mata da Amém) (FNRC)	PB
Reserva Ecológica Mata do Pau-Ferro, município de Areia (RMPF)	PB
Reserva Biológica Guaribas (RBG)	PB
Reserva Biológica Saltinho (RBS)	PE
Parque Estadual das Dunas do Natal (PEDN)	RN

Além dos inventários, foram analisados materiais provenientes de empréstimo dos herbários, UFRN – Fungos (Rio Grande do Norte), JPB (Paraíba) e URM (Pernambuco) (Thiers, constantemente atualizado); e ainda materiais da coleção pessoal do Prof. Dr. Felipe Wartchow, coletados no (1) Parque Nacional de Ubajara – PNU (CE), (2) Parque Estadual Serra do Conduru - PESC (BA) e na região entre os municípios de Abaíra e Itaetê, Chapada Diamantina - AICD (BA).

1.3.2 Procedimentos de Coleta

Excursões de coleta foram efetuadas no período compreendido entre março de 2016 e setembro de 2017, preferencialmente durante o período chuvoso das respectivas áreas de estudo. Para efetuar a coleta do material micológico foi empregado o método da caminha, de modo a percorrer o máximo da área total de cada ponto de coleta visitado, dando ênfase às áreas de maior umidade, como cursos d'água e locais com maior concentração de árvores emergentes.

Os basidiomas encontrados foram coletados inteiros com auxílio de canivete ou talhadeira, juntamente com uma pequena porção do seu substrato. Foram registradas informações de data, coletor, altitude, vegetação, substrato e coordenadas geográficas. Os basidiomas foram armazenados em caixa plástica compartimentada ou em cesta térmica de piquenique, e os fragmentos destinados aos estudos moleculares foram segregados e submetidos aos procedimentos explicitados na seção 5.3. Os basidiomas frescos foram fotografados *in loco* e o registro de caracteres morfológicos, indispensáveis para a identificação, ocorreu em ponto de apoio no sítio de coleta ou no laboratório.

A ficha de coleta utilizada foi desenvolvida pelo amanitólogista R. E. Tulloss e encontra-se disponível (ANEXO A).

1.3.3 Secagem e Acondicionamento de Amostras para Estudos Moleculares

A fim de obter fragmentos devidamente desidratados para futuros estudos moleculares, o seguinte procedimento foi realizado (YANG, comunicação pessoal):

1. Foi retirado um pequeno fragmento (1-2 × 1–- cm, e 0,2-0,4 cm de espessura) das lamelas e do contexto (píleo) do cogumelo;
2. Posteriormente, em saco *zip lock* (Nº 1), o fragmento foi imergido em sílica-gel atóxica (cor laranja);
3. O material imergido foi deixado de 10-24 horas em processo de desidratação, enquanto ocorria a mudança gradual de cor da sílica-gel;
4. O fragmento devidamente seco foi, então, retirado da sílica-gel e colocado em tubos Eppendorf de 1,5 ml;
5. Por fim, os tubos contendo as amostras foram devidamente etiquetados e acondicionados em freezer a -20 °C.

1.3.4 Herborização

Após a descrição macroscópica, os basidiomas coletados foram desidratados em um desidratador de frutas portátil, sob temperatura de aproximadamente 40 °C para herborização. Depois de desidratado, o material foi envolvido em envelope de papel manteiga, e, por fim, acondicionado em saco plástico, com fecho zip lock contendo: (1) poucos grânulos de sílica-gel; (2) ficha com a descrição macroscópica e; (3) rótulo com informações de campo (nº de coletor, nº de fotografia, etc.). Os materiais foram depositados no Herbário Lauro Pires Xavier (JPB) e/ou no Herbário Padre Camilo Torrend (URM). Algumas duplicatas foram enviadas para o Herbário do Delta do Parnaíba (HDELTA).

1.3.5 Análise Morfoanatômica

O estudo dos espécimes foi realizado no Laboratório Morfo-Taxonomia Fúngica do Departamento de Sistemática e Ecologia, no Centro de Ciências Exatas e da Natureza da Universidade Federal da Paraíba (UFPB).

1.3.5.1 Macroscopia

Os espécimes ainda frescos (mesmo dia de coleta) foram descritos macroscopicamente com a obtenção também de novas fotografias no laboratório. A análise contemplou os seguintes itens:

a) *Basidioma:* tamanho, hábito, habitat e desenvolvimento;
b) *Píleo:* tamanho, forma, coloração, superfície, disco e margem;
c) *Lamelas:* forma, fixação ao estipe, coloração, margem, textura, espaçamento e número de lamélulas;
d) *Estipe:* tamanho, forma, posição, coloração, consistência, superfície, ápice e base;
e) *Contexto:* espessura e coloração;
f) *Véu parcial:* tipo, disposição, coloração, textura e superfície;
g) *Véu universal:* tipo, disposição, coloração, textura e superfície.

Todas as referências de cores adotadas então em conformidade com Kornerup & Wanscher (1978). No que tange à terminologia, foram considerados fundamentalmente os trabalhos de Corner & Bas (1962), Bas (1969), Largent (1986) e Kirk *et al*. (2008).

1.3.5.2 Microscopia

Para a análise anatômica, foram preparadas lâminas com cortes do material em água destilada, 50 g/L hidróxido de potássio (KOH), 10 g/L Vermelho Congo ou reagente de Melzer. A análise contemplou os seguintes itens:

a) *Basidiósporos:* tamanho, forma, coloração, conteúdo, ornamentação (se presente), amiloidia, apículo e parede;

b) *Basídios:* tamanho, forma, coloração, abundância, conteúdo, parede, presença ou ausência de grampo de conexão no septo basal e número de esterigmas/esporos;
c) *Trama da lamela:* arranjo e coloração. Hifas: diâmetro, forma, incrustação, septação e parede;
d) *Tecido marginal das lamelas:* forma e dimensões das células (elementos);
e) *Sub-himênio:* tipo, coloração e número de camadas. Hifas: forma, diâmetro e disposição;
f) *Contexto/Trama:* coloração. Hifas: diâmetro, disposição, incrustação, septação e caracterização de acrofisálides;
g) *Pileipellis (Amanita):* tipo, diâmetro, coloração e camadas. Hifas: disposição, diâmetro, forma, incrustação, parede e caracterização das células/elementos terminais;
h) *Véu parcial:* hifas: disposição, coesão, diâmetro e forma;
i) *Véu universal (Amanita):* distribuição, camadas, proporção entre hifas e células infladas, disposição e coesão dos elementos;
j) *Hifas de suporte do glúten volval (Limacella):* diâmetro, coloração e camadas. Hifas: disposição, diâmetro, forma, incrustação, parede e caracterização dascélulas/elementos terminais.

Para o tratamento e exposição dos valores biométricos foi adotada a metodologia modificada, de Tulloss *et al.* (1992) e Tulloss (1993, 1994, 1998, 2000), a qual é sumarizada em Tullos & Lindgreen (2005). A terminologia das microestruturas está de acordo com os trabalhos de Corner & Bas (1962), Bas (1969), Largent et al. (1977), Yang (1997, 2005) e Kirk *et al*. (2008).

1.3.6 Identificação das Espécies

Foi priorizada a identificação morfológica das espécies. Os dados moleculares obtidos no decorrer do projeto não foram utilizados neste estudo.

Para a identificação dos materiais, foram utilizados principalmente os trabalhos de Bas (1969, 1978, 2000), Corner & Bas (1962), Gminder (1994), Meijer (2001, 2006), Neville & Poumarat (2004), Pegler (1983), Singer (1975, 1986), Smith (1945), Tulloss (1993, 1994, 1998, 2000, 2005), Tulloss & Yang (2016), Tulloss *et al*. (1992, 2016), Wartchow (2015, 2016), Wartchow & Maia (2007), Wartchow *et al*. (2007b, 2009, 2013a, 2013b, 2015a, 2015b), Yang (1997, 2000, 2005).

2 RESULTADOS E DISCUSSÃO

Foram analisadas 30 exsicatas da família Amanitaceae, provenientes de (1) coletas realizadas no período entre março de 2016 e setembro de 2017; (2) coleções já depositadas nos seguintes herbários: UFRN – Fungos (Rio Grande do Norte), JPB (Paraíba) e URM (Pernambuco), ou ainda do; (3) acervo pessoal do prof. Dr. Felipe Wartchow. Além disso, quando necessário, materiais adicionais de outras localidades ou holótipo de espécies de interesse foram analisados.

Nos materiais analisados, a família Amanitaceae foi representada por 16 espécies de *Amanita* e uma espécie de *Limacella*. Das espécies de *Amanita*, seis foram registradas para o subgênero *Amanita*, e nove para o subgênero *Lepidella*. A nível seccional, as espécies foram distribuídas com a seguir: uma em seção *Amanita*, quatro em seção *Lepidella*, uma em seção *Phalloideae*, cinco em seção *Vaginatae*, e cinco em seção *Validae*.

Dentre as espécies de *Amanita* identificadas, 13 espécies novas foram descritas (*A. adamantina*, *A. alboturbinata*, *A. aureonauseosa*, *A. aureonitida*, *A. eburneopileata*, *A. dulceodora*, *A. flavosulcatissima*, *A. fragilissima*, *A. griseocrenulata*, *A. griseoesplendida*, *A. helenae*, *A. melliodora*, *A. velutina*), e *A. nauseosa* constitui uma nova citação para o Brasil. Além disso, *A. lippiae* e *A. psammolimbata* foram redescritas e transferidas, respectivamente, para as seções *Vaginatae* e *Lepidella*.

A distribuição das espécies de *Amanita* por área revelou predominância de espécies no PEDN, totalizando cinco espécies, sendo três de ocorrência exclusiva em comparação com as demais áreas: *A. alboturbinata*, *A. griseocrenulata* e *A. velutina*. Anteriormente, apenas *A. viscidolutea* era conhecida para o referido parque.

O PEDN possui grande similaridade fitofisionômica, edáfica e climática com a RBG, e juntos responderam pela ocorrência de oito espécies, sendo *A. griseoesplendida* de ocorrência comum às duas áreas. Nesse contexto, sendo *Amanita* um gênero EMC bastante conhecido, a maior riqueza observada nesses locais corrobora com Singer & Araujo (1979), os quais apontam que florestas ECM tropicais ocorrem em solos de areia branca altamente oligotróficos. Nestas condições, a maior diversidade de fungos ECM serviria não somente para promover o crescimento dos hospedeiros pelo aumento da captação de nutrientes em solo empobrecido, mas também para aumentar a tolerância de altos níveis de minerais presentes nessas zonas de água do mar e de influência costeira (READ, 1998; BOIS *et al*., 2006).

Nas áreas amostradas do município de Ilha Grande (PI), apesar da grande diversidade vegetal em ecossistemas arenícolas oligotróficos, não foi observada a ocorrência de espécies de

Amanita. Entretanto, tal fato pode ser atribuído ao período com baixa incidência de chuvas em que as coletas ocorreram na região.

Para o gênero *Limacella*, apenas uma espécie foi determinada, a qual representa um novo táxon para ciência, sendo alocada na seção *Amanitellae*. Para fins de comparação, também foram analisadas coleções de *L. ochraceolutea* depositadas nos herbários HCP e JPB. Esta última representa o único registro confiável de *Limacella* para o Brasil, uma vez que *L. illinita*, *L. glischra* e *L. guttata* possuem citação apenas em *checklists*, sem nenhuma caracterização morfoanatômica ou menção acerca do tombamento em herbário.

Os epítetos das espécies novas aqui descritas serão publicados efetivamente, de modo que esta publicação não deva ser considerada para efeitos taxonômicos, conforme orientado pelos artigos 30.8 e 36.1 do Código Internacional de Nomenclatura para algas, fungos e plantas de Melbourne (MCNEILL *et al.*, 2012). Tais nomes são disponibilizados aqui para melhor apresentação dos resultados e correta organização do texto. Quando da submissão dos artigos, serão também providenciados os números de registro no *MycoBank*, *Index Fungorum* e *Facesoffungi* para as novas espécies.

Os artigos elaborados a partir dos resultados encontram-se na seção de apêdices, e as normas de formatação estão de acordo com o periódico ao qual foram submetidos ou pretende-se submeter para publicação.

Tabela 5 - Espécies coletadas e respectivos locais de coleta, registros e referências bibliográficas.

Táxon	***Seção***	***Vouchers***	***Local***	***Novo registro***	***Referência***
Limacella					
Limacella brunneovenosa	*Amanitellae*	JPB 62772	**FNRC**	EN	APÊNDICE A
Amanita					
Amanita dulceodora	*Lepidella*	JPB 60534	**PESC**	EN	APÊNDICE B
Amanita eburneopileata	*Validae*	----	**AICD, RBG**	EN	APÊNDICE C
Amanita velutina	*Validae*	----	**PEDN**	EN	APÊNDICE C
Amanita aureonitida	*Validae*	----	**RBG**	EN	APÊNDICE D
Amanita griseoesplendida	*Validae*	----	**PEDN, RBG**	EN	APÊNDICE D
Amanita melliodora	*Validae*	----	**RBG**	EN	APÊNDICE D
Amanita aureonauseosa	*Lepidella*	----	**PNU**	EN	APÊNDICE E
Amanita alboturbinata	*Lepidella*	----	**PEDN**	EN	APÊNDICE E
Amanita nauseosa	*Lepidella*	UFRN-Fungos 1874	**PEDN**	BR	APÊNDICE E
Amanita flavosulcatissima	*Amanita*	URM 84452 URM 84453	**RBS**	EN	APÊNDICE E

Amanita helenae	*Vaginatae*	----	**RMPF**	EN	APÊNDICE F
Amanita fragilissima	*Vaginatae*	----	**UFPB**	EN	APÊNDICE F
Amanita adamantina	*Vaginatae*	----	**AICD**	EN	APÊNDICE F
Amanita griseocrenulata	*Vaginatae*	----	**PEDN**	EN	APÊNDICE F
Amanita lippiae	*Vaginatae*	----	*	*	Nesta seção
Amanita psammolimbata	*Phalloideae*	UFRN-Fungos 1870 JPB 60531	*	*	Nesta seção

AICD = Abaíra e Itaetê, Chapada Diamantina; BR = Brasil; EN = Espécie Nova; **FNRC** = Floresta Nacional da Restinga de Cabedelo; **PEDN** = Parque Estadual das Dunas do Natal; **PESC** = Parque Estadual Serra do Conduru; **PNU** = Parque Nacional de Ubajara; **RBG** = **Reserva Biológica Guaribas**; **RBS** = Reserva Biológica Saltinho; **RMPF** = Reserva Ecológica Mata do Pau-Ferro; **UFPB** = *Campus* I da Universidade Federal da Paraíba. * Espécies que tiveram seu holótipo reavaliado e a posição taxonômica seccional modificada.

2.1 TAXONOMIA

2.1.1 *Amanita*

Chave de identificação para seções de *Amanita,* de acordo com Bas (1969), Tulloss *et al*. (1992) e Yang (1997).

1. Esporos amiloides. Margem pilear raramente radialmente sulcada. Lamélulas frequentemente atenuadas…..........……………..…………………..…...**2 (subgênero *Lepidella)***

1’. Esporos inamiloides. Margem pilear na maioria radialmente sulcada. Lamélulas frequentemente truncadas…………………..……**7** (**subgênero A*manita)***

2. Véu universal pulverulento ou quebrando-se em flocos, verrugas, escamas, fragmentos, correias ou crostas no píleo e estipe; às vezes desaparecendo completamente da base do estipe. Se o bulbo basal é marginado, então véu universal flocoso ou formando verrugas cônicas, pelo menos na porção central do píleo, e nunca provido de uma camada externa (sub)membranosa..**3**

2’. Véu universal circunséssil, limbado ou sacado………………................……………….**4**

3. Margem pilear não apendiculada. Pileipellis frequentemente provido de coloração distinta. Esporos globosos a elipsoides, na maioria < 10 µm, raramente até 12 µm long. Véu parcial membranoso, raramente fagáceo (evanescente)……….......................................**seção *Validae***

3’. Margem pilear apendiculada. Pileipellis raramente provido de coloração distinta. Esporos globosos a baciliformes, frequentemente > 10 µm long. Véu parcial membranoso a friável...**seção *Lepidella***

4. Véu universal circunséssil ou limbado, quebrando-se na superfície pilear em fragmentos submembranosos (ou raramente pulverulentos ou flocosos) e deixando um limbo (ou fragmentos) levemente (sub) membranoso na base do estipe, ou também bulbo distintamente marginado. Remanescentes do véu universal nunca como verrugas cônicas ……….......……**5**

4’. Véu universal sacado, formando um saco membranoso na base do estipe e apenas ocasionalmente formando um ou poucos fragmentos membranosos no píleo; mas às vezes camada interna do véu universal friável e formando escamas, fragmentos ou pulverulência no píleo **6**

5. Margem pilear apendiculada. Esporos largamente elipsoides a baciliformes. Véu parcial membranoso, friável ou fugáceo……………..…........**seção *Lepidella***

5’. Margem pilear não apendiculada. Esporos globosos a subglobosos. Véu parcial membranoso..**seção *Phalloideae***

6. Pileipellis frequentemente com coloração distinta, geralmente com margem não estriada. Esporos globosos a elipsoides, ou infrequentemente cilíndricos ou baciliformes (< 10% das espécies conhecidas). Véu parcial membranoso. Véu universal sem camada interna friável. Lamellas não escurecendo drasticamente após processo lento de secagem.. **seção *Phalloideae***

6’. Pileipellis geralmente branco ou acastanhado, com margem frequentemente estriada. Esporos predominantemente largamente elipsoides a baciliformes, porém subglobosos em um táxon. Véu parcial frequentemente friável. Véu universal alguma vezes com uma camada interna friável. Lamelas geralmente escurecendo fortemente após processo lento de secagem...**seção *Amidella***

7. Presença de bulbo na base do estipe. Véu universal geralmente friável, às vezes limbado…...…**Seção *Amanita***

7’. Ausência de bulbo na base do estipe. Véu universal geralmente sacado, ocasionalmente friável...**seção *Vaginatae***

2.1.1.1 Amanita seção *Amanita*

2.1.1.1.1 Amanita flavosulcatissima

Autoria: C.C. Nascimento, V.R.M. Coimbra & Wartchow, sp. nov.

Descrição: APÊNDICE E.

Distribuição conhecida: conhecida apenas para a localidade tipo, na REBIO de Saltinho, Tamandaré, Pernambuco, Brasil.

Hábito e Habitat: crescendo em solo, solitário ou cespitoso, em grupos de poucos indivíduos. Possivelmente é uma espécie ectomicorrízica, porém mais estudos são necessários para averiguar essa informação.

Material examinado: Brasil. **Pernambuco**, Tamandaré, REBIO Saltinho, 03 VII 2011, leg. V.R.M. Coimbra & L.S. Araújo-Neta (URM 84452). **Pernambuco**, Tamandaré, REBIO Saltinho, 05 IX 2011, leg. V.R.M. Coimbra & L.S. Araújo-Neta (URM 84453).

Comentários: APÊNDICE E.

2.1.1.2 *Amanita* seção *Lepidella*

2.1.1.2.1 Amanita alboturbinata

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE E.

Distribuição conhecida: conhecida apenas para a localidade tipo, no Parque Estadual das Dunas do Natal – PEDN, Trilha da Geologia, Natal, Brasil.

Hábito e Habitat: solitário, crescendo em floresta tropical nativa em região de dunas costeiras (Bioma Mata Atlântica).

Material examinado: Brasil. **Rio Grande do Norte**, Natal, Parque Estadual das Dunas do Natal (PEDN), 05 VII 2017, leg. A.G. Santos AGS860 (JPB).

Comentários: APÊNDICE E.

2.1.1.2.2 Amanita aureonauseosa

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE E.

Distribuição conhecida: conhecida apenas para a localidade tipo, no Parque Nacional de Ubajara, Ubajara, Brasil.

Hábito e Habitat: espalhados, crescendo em solo em região de Floresta Ombrófila Aberta, nas proximidades de pequenos cursos d’água.

Material examinado: Brasil. **Ceará**, Ubajara, Parque Nacional de Ubajara, 29 XI 2012, F. Wartchow *et al*. FW 143/2012 (JPB).

Comentários: APÊNDICE E.

2.1.1.2.3 *Amanita dulceodora*

Autoria: C.C. Nascimento, Sá & Wartchow, sp. nov.

Descrição: APÊNDICE B.

Distribuição conhecida: conhecida apenas para a localidade tipo, no Parque Estadual Serra do Conduru (PESC), Uruça, Brasil.

Hábito e Habitat: solitário ou disperso em solo argiloso em área de Floresta Ombrófila Densa (Bioma Mata Atlântica), acerca de 300 m alt.

Material examinado: Brasil. **Bahia**, Uruçuca, Parque Estadual da Serra do Conduru, 29 XI 2012, *F. Wartchow et al*. FW 143/2012 (holo-: JPB 60534!); **Bahia**, Uruçuca, Parque Estadual da Serra do Conduru, 28 XI 2012, F. Wartchow *et al*. FW 134/2012 (JPB).

Comentários: APÊNDICE B.

2.1.1.2.4 *Amanita nauseosa*

Autoria: (Wakef.) D.A. Reid

Descrição: APÊNDICE E.

Distribuição conhecida: Brasil (presente registro); Martinica; UK (Escócia, Inglaterra); USA (Florida, Marilândia, Mississippi, Texas), México.

Hábito e Habitat: em gramado, no *Campus* da Universidade Federal de Pernambuco (UFPE), no Recife; em solo de Floresta Ombrófila Densa, no Campus I da Universidade Federal da Paraíba (UFPB), João Pessoa; em solo arenoso, no Parque Estadual das Dunas do

Natal, em Natal. Em todas as localidades o hábito caracterizou-se por poucos basidiomas crescendo próximos.

Material examinado: Brazil: **Paraíba**, João Pessoa, Portal do Sol, 20 VI 2015, Wartchow F., FW 20/2015 (JPB); **Pernambuco**, Recife, *Campus* da Universidade Federal de Pernambuco, 27 V 2014, Wartchow F., FW 27/2014 (JPB); **Rio Grande do Norte**, Natal, Parque Estadual das Dunas do Natal (PEDN), 18 V 2011, Sulzbacher M., 309 (UFRN-Fungos 1874).

Comentários: APÊNDICE E.

2.1.1.3 *Amanita* seção *Phalloideae*

2.1.1.3.1 Amanita psammolimbata

Autoria: Wartchow & Sulzbacher

Descrição: A descrição macromorfológica não será repetida nesta seção, de modo que apenas uma pequena correção a respeito da margem pilear será realizada. Foi descrita como apendiculada, mas análises baseadas nas fotos dos basidiomas frescos e também do material depositado em herbário apontaram para a ocorrência de uma margem pilear nitidamente não apendiculada.

As características microscópicas serão redescritas em sua totalidade para facilitar o processo de comparação – ***Basidiósporos*** [40/1/1] (8.5–)9.3–12(–12.5) × (5–)5.5–7.2(–7.8) µm [**L** = 10.5 µm; **W** = 6.6 µm; Q = (1.32–) 1.35–1.85(–2.00); **Q** = 1.60], amiloides, hialinos, sem cor, elipsoides a alongados, lisos e com parede fina, conteúdo monogutulado; apículo obtuso, curto, sublateral a subapical. ***Basídios*** 32–50 × 9–13, clavados, 4-esporados, esterigmas usualmente longos (até 7 µm), grampos de conexão não observados. ***Subhimênio*** constituído usualmente de 3–4 camadas de células; células globosas, subglobosas, largamente elipsoides a largamente clavadas (8–16 × 6–14 µm), hialinas, sem cor, parede fina. ***Trama lamelar*** bilateral divergente, com ângulo de divergência sutíl; estrato central com 25–30 µm de espessura; hifas filamentosas (2–6 µm de diâmetro), relativamente abundantes, ramificadas; células infladas clavadas a fusiformes (38–62 × 10–20 µm), parede fina; hifas vasculares raras. ***Tecido lamelar marginal*** estéril; hifas filamentosas **(**1.5–4 µm de diâmetro), hialinas, sem cor, parede fina; células infladas na sua maioria largamente clavadas a piriformes (20–30 × 12–20 µm), dominantes, sem cor, parede fina, isoladas ou ocasionalmente em cadeia de 2–3 células. ***Pileipelis*** até 85 µm de espessura, não gelatinizado**;** hifas filamentosas **(**2–5 µm de diâmetro), prostradas e radialmente orientadas, sem cor, frequentemente ramificadas. ***Véu universal*** – *No píleo*: células infladas (25–55 × 22–40 µm) na maioria globosas, subglobosas a ovoides, mas também largamente clavadas a piriformes, hialinas, sem cor, parede fina ou levemente espessada (≤ 0.5 µm); hifas filamentosas (2–7 µm de diâmetro), abundantes, entrelaçadas, parede fina; hifas vasculares não observadas. *Interior do limbo volval na base do estipe*: formado por elementos longitudinalmente ou irregulamente arranjados; células infladas na maioria golobosas, subglobosas a piriformes (20–70 × 14.5–60 µm), mas também largamente clavadas a alongadas (até 68–40 µm), sem cor, paredes finas ou levemente espessadas (≤ 0.7 µm); hifas filamentosas (2–6 µm de diâmetro) relativamente abundantes, hialinas, parede fina; grampos de conexão ausentes; hifas vasculares não observadas; *camada externa do limbo volval*: similar a camada interior, no entando hifas filamentosas (2.5–6 µm de diâmetro) dominantes; *camada mais interna do limbo volval* levemente gelatinizada, formada quase exclusivamente por hias filamentosas (2–7 µm de diâmetro). ***Limbus internus*** *não encontrado*. ***Véu parcial*** não encontrado.

Distribuição conhecida: conhecida apenas para a localidade tipo, no Parque Estadual das Dunas do Natal – PEDN, Trilha da Geologia, Natal, Brasil.

Hábito e Habitat: solitário, crescendo em floresta tropical nativa em região de dunas costeiras (Bioma Mata Atlântica).

Material examinado: Brasil, **Rio Grande do Norte, Natal**, Parque Estadual das Dunas do Natal, Trilha da Geologia, 10 V 2011, leg. *M.A. Sulzbacher MAS 325* (holo-: UFRN-Fungos 1870!; Iso-: JPB 60531!).

Comentários: a presente espécie teve sua posição seccional retificada para *Amanita* seção *Phalloideae* devido a presença de (1) margem pilear não apendiculada, (2) véu parcial percistente, (3) base bulbosa e (4) véu universal membranoso e limbado na base do estipe.

Ilustrações: em Wartchow *et al.* (2015b).

2.1.1.4 *Amanita* seção *Vaginatae*

2.1.1.4.1 Amanita helenae

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE F.

Distribuição conhecida: conhecida apenas para a localidade tipo, no Parque Estadual Mata do Pau-Ferro, Areia, Brasil.

Hábito e Habitat: solitário, crescendo em solo argiloso coberto por serapilheira em brejo de altitude.

Material examinado: Brasil. **Paraíba**, Areia, Parque Estadual Mata do Pau-Ferro, Trilha do Combe, 20 VII 2017, leg. *C.C. Nascimento* & *F. Wartchow* CN056 (holo-: JPB); **Paraíba**, Areia, Parque Estadual Mata do Pau-Ferro, Trilha do Engenho Triunfo, 30 IV 2011, leg. *F. Wartchow s.n.* (JPB).

Comentários: APÊNDICE F.

2.1.1.4.2 *Amanita fragilissima*

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE F.

Distribuição conhecida: conhecida apenas para a localidade tipo, em um fragmento de Mata Atlântica, localizado no *Campus* I da Universidade Federal da Paraíba (UFPB).

Hábito e Habitat: solitário, crescendo em solo argiloso, coberto por serapilheira em um fragmento de Mata Atlântica.

Material examinado: Brasil. **Paraíba**, João Pessoa, *Campus* I da Universidade Federal da Paraíba (UFPB), 9 IX 2016, leg. *C.C. Nascimento* & *F. Wartchow* CN040 (JPB); **Paraíba**, João Pessoa, *Campus* I da Universidade Federal da Paraíba (UFPB), 9 IX 2016, leg. *C.C. Nascimento* & *F. Wartchow* CN041 (JPB).

Comentários: APÊNDICE F.

2.1.1.4.3 *Amanita adamantina*

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE F.

Distribuição conhecida: conhecida apenas para a localidade tipo, na região da Chapada da Diamantina, Bahia, Brasil.

Hábito e Habitat: solitário, crescendo em solo argiloso em área de mata nebular (sensu Zappi *et al*. 2003), a cerca de 1700 m alt. De acordo com estes autores, *Guapira obtusata* (Jacq.) Little (1000–1850 m alt.) e *Coccoloba brasiliensis* Nees & Mart. (1000–1700 m alt.), são árvores putativamente EMC, encontradas em altitude similar a da nova espécie.

Material examinado: Brasil. **Bahia**, Chapada da Diamantina, Abaíra, Catolés de Cima, Serra do Barbado, Mata do Tijuquinho 9 I 2015, leg. *F. Wartchow et al*. FW 05/2015 (JPB).

Comentários: APÊNDICE F.

2.1.1.4.4 *Amanita griseocrenulata*

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE F.

Distribuição conhecida: conhecida apenas para a localidade tipo, no Parque Estadual das Dunas do Natal – PEDN, Trilha Peroba, Natal, Brasil.

Hábito e Habitat: solitário, crescendo em floresta tropical nativa em região de dunas costeiras (Bioma Mata Atlântica).

Material examinado: Brasil. **Rio Grande do Norte**, Natal, Parque Estadual das Dunas do Natal (PEDN), Trilha Peroba, 08 VI 2017, leg. A.G. Santos AGS853 (JPB).

Comentários: APÊNDICE F.

2.1.1.4.5 *Amanita lippiae*

Autoria: Wartchow & Tulloss

Descrição: A descrição macromorfológica não será repetida nesta seção, de modo que apenas discussões a respeito da interpretação do bulbo e do véu universal na base do estipe serão levantadas na seção de comentários.

As características microscópicas serão redescritas em sua totalidade para facilitar o processo de comparação – ***Basidiósporos*** [120/4/1] (9.5–) 10.5–20(–21) × (6.5–)7.2–11.5(–12) µm [**L** = 13–14 µm; **L’** = 13.7 µm; **W** = 7.2–8.5 µm; **W’** = 7.9 µm; Q = (1.32–) 1.39–2.38(–2.4); **Q** = 1.75–1.89; **Q’** = 1.79], inamiloides, hialinos, elipsoides a alongados, ocasionalmente cilíndricos, lisos, parede fina, levemente achatados de forma adaxial, conteúdo gutulado; apículo proeminente, obtuso, sublateral. ***Basídios*** 35–62 × 10–16 µm, clavados, 4-esporados; grampos de conexão não observados. ***Subhimênio*** até 30 µm de espessura, ramoso a infladoramoso. ***Trama lamelar*** bilateral divergente, com hifas filamentosas e elementos inflados, divergindo gradualmente do estrato central; hifas filamentosas (2–10 µm de diâmetro), ramificadas, parede fina. ***Tecido lamelar marginal*** formado por células infladas, globosas a subglobosas (até 38–30 µm), geralmente em cadeia de 2–3 células; hifas filamentosas (1.5–6 µm de diâmetro), abundantes, ramificadas, entrelaçadas. ***Pileipelis*** com até 140 µm de espessura, constituída de duas camadas; *suprapelis* de até 50 µm de espessura, levemente gelatinizada; hifas filamentosas (2–5 µm de diâmetro); hifas vasculares às vezes presente; *subpelis* com até 90 µm de espessura, marrom pálido; hifas filamentosas (3–6.5 µm de diâmetro); hifas vasculares raras. ***Véu universal*** – *No píleo*: hifas filamentosas (3–12 µm de diâmetro), ramificadas, abundantes, parede fina ou levemente espessadas (≤ 5µm) com incrustações ocasionais; células infladas globosas, subglobosas a ovoides (25–70× 19–58 µm), hialinas, sem cor, com paredes de até 1 µm de espessura; hifas vasculares não observadas; *no bulbo*: semelhante aos elementos do véu universal do píleo, no entanto com maior proporção de hifas filamentosas (2–12 µm de diâmetro).

Distribuição conhecida: conhecida apenas para a localidade tipo.

Hábito e Habitat: crescendo espalhado, em solo arenoso sob árvores de “alecrim-de-cheiro” (uma espécie de *Lippia* L., Verbenaceae).

Material examinado: Brasil.l **Pernambuco**, Buíque, Parque Nacional do Catimbau, “Trilha do Cânion” (08º31′ 41″ S, 37º 14′ 48″ W, 879 m elev.), 3 VII 2006, leg. *B.T. Goto, E.R. Drechsler-Santos & F. Wartchow s.n.* (URM).

Comentários: Wartchow *et al.* (2009) descreveram *A. lippiae* a partir de uma única coleção, classificando-a em *Amanita* seção *Amanita* em decorrência dos esporos amiloides e da presença de bulbo basal. No entanto, a reexaminação do tipo realizada neste estudo sugere que *A. lippiae* deve ser melhor acomodada em *Amanita* seção *Vaginatae*. Isso se deve a uma melhor interpretação da suposta presença de um bulbo na base do estipe, uma vez que apenas os estágios mais juvenis possuem tal característica. Assim, o bulbo basal provavelmente sofre um alongamento tardio, de modo que apenas os basidiomas maduros não o possuem. Em adição, a presença de uma volva aderida e multilobada na base do estipe também pode contribuir para a falsa percepção de um bulbo basal nos basidiomas maduros.

A circunscrição de *A. lippia* dentro de *Amanita* seção *Vaginatae* também foi confirmada a partir de dados moleculares [ITS (KP258991), nLSU (KP258992)].

Ilustrações: em Wartchow *et al.* (2009).

2.1.1.5 *Amanita* seção *Validae*

2.1.1.5.1 Amanita aureonitida

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE D.

Distribuição conhecida: conhecida apenas para a localidade tipo, em REBIO Guaribas SEMA I, Mamanguape, Brasil.

Hábito e Habitat: solitário, crescendo em solo arenoso em área de Floresta Ombrófila Densa (Bioma Mata Atlântica).

Material examinado: Brasil. **Paraíba**, Mamanguape, REBIO Guaribas I, 13 VII 2017, leg. C.C. Nascimento CN068 (JPB).

Comentários: APÊNDICE D.

2.1.1.5.2 Amanita eburneopileata

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE C.

Distribuição conhecida: ocorre nos estados da Bahia (Chapada da Diamantina) e Paraíba (REBIO Guaribas SEMMA I).

Hábito e Habitat: solitário, crescendo em solo arenoso em área de Floresta Ombrófila Densa (Bioma Mata Atlântica).

Material examinado: Brasil. **Paraíba**, Mamanguape, REBIO Guaribas I, 30 VI 2012, leg. *F. Wartchow* FW 109/2012 (JPB); **Bahia**, Chapada da Diamantina, Abaíra, Catolés de Cima, Serra do Barbado, Mata do Tijuquinho 9 I 2015, *F. Wartchow et al*. FW 07/2015 (JPB).

Comentários: APÊNDICE C.

2.1.1.5.3 *Amanita griseosplendida*

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE D.

Distribuição conhecida: ocorre nos estados da Paraíba (REBIO Guaribas SEMMA I) e Rio Grande do Norte (Parque Estadual das Dunas do Natal – PEDN).

Hábito e Habitat: solitário, crescendo em floresta tropical nativa em região de dunas costeiras (Bioma Mata Atlântica).

Material examinado: Brazil. **Rio Grande do Norte**, Natal, Parque Estadual das Dunas do Natal (PEDN), 05 VII 2017, leg. A.G. Santos AGS877 (JPB); **Paraíba**, Mamanguape, REBIO Guaribas I, 20 IX 2017, leg. C.C. Nascimento CN000 (JPB).

Comentários: APÊNDICE D.

2.1.1.5.4 *Amanita melliodora*

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE D.

Distribuição conhecida: conhecida apenas para a localidade tipo, em REBIO Guaribas SEMA I, Mamanguape, Brasil.

Hábito e Habitat: solitário, crescendo em solo arenoso em área de Floresta Ombrófila Densa (Bioma Mata Atlântica).

Material examinado: Brazil. **Paraíba**, Mamanguape, REBIO Guaribas I, 20 I 2014, leg. F. Wartchow FW 22/2014 (JPB).

Comentários: APÊNDICE D.

2.1.1.5.5 *Amanita velutina*

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE C.

Distribuição conhecida: conhecida apenas para a localidade tipo, no Parque Estadual das Dunas do Natal, Trilha da Geologia, Natal, Brasil

Hábito e Habitat: solitário a subgregário, crescendo em floresta tropical nativa em região de dunas costeiras (Bioma Mata Atlântica).

Material examinado: Brasil. **Rio Grande do Norte**, Natal, Parque Estadual das Dunas do Natal (PEDN) – Trilha da Geologia, 18 V 2011, leg. M. Sulzbacher MS0349 (JPB); Natal, Parque Estadual das Dunas do Natal, 23 VI 2007, *E.P. Fazolino & B.D. Silva* s.n *et al.* FW 134/2012 (URM).

Comentários: APÊNDICE C.

2.1.2 *Limacella*

Chave de identificação para seções de *Limacella*, de acordo com Singer (1986) e Gminder (1997).

1. Estipe completamente víscido ou glutinoso abaixo do véu universal…..…...***seção Lubricae***

1'. Estipe seco ou não-víscido/glutinoso (pelo menos em parte) …......................................…**2**

2. Células terminais das hifas de sustentação do glúten não cônicas e nunca surgindo a partir de hifas com células intercalares infladas...**seção *Limacella***

2'. Células terminais das hifas de suporte de glúten em forma cônica ou subcônica; tais células frequentemente possuindo uma ou mais células subjacentes, as quais são distintamente infladas (globosa, subglobosa, largo-elipsoide, etc.)…...……...................... **seção *Amanitellae***

2.1.2.1 Seção *Amanitellae*

2.1.2.1.1 Limacella brunneovenosa

Autoria: C.C. Nascimento & Wartchow, sp. nov.

Descrição: APÊNDICE A.

Distribuição conhecida: conhecida apenas para a localidade tipo, na Floresta Nacional da Restinga de Cabedelo, Paraíba, Brasil.

Hábito e Habitat: crescendo aos pares (conectados pela base, conado), em solo arenoso em área de restinga (Bioma Mata Atlântica).

Material examinado: **Brasil**. Paraíba, Cabedelo, Floresta Nacional Restinga de Cabedelo, Mata da AMEM, 12 VII 2012, *F. Wartchow 119/2012* (JPB 62772, holotype).

Comentários: APÊNDICE A.

3 CONCLUSÃO

Os resultados deste trabalho fornecem informações novas sobre a diversidade e distribuição das espécies de *Amanitaceae* em áreas do nordeste brasileiro, especialmente para os estados da Paraíba, Pernambuco e Rio Grande do Norte. Eles demonstraram que a riqueza de espécies da família é considerável, pois foram descobertas 13 novas espécies para a ciência e um novo registro para o Brasil, ampliando o conhecimento sobre a diversidade desses fungos e evidenciando a importância da conservação da Mata Atlântica e da Caatinga, em especial das áreas estudadas. Ademais, a revisão do holótipo de *A. lippiae* e *A. psammolimbata* permitiu reconfigurar o posicionamento taxonômico, ao passo que apontou para a importância da realização de revisões sistemáticas das espécies de *Amanita* depositadas nos herbários brasileiros para fins de ratificação taxonômica.

O estudo também permitiu verificar a ocorrência no Brasil de quatro das sete seções aceitas para o gênero *Amanita*. A seção *Validae* foi a mais representativa em número de espécies nas áreas estudadas, e um total de cinco espécies novas foram descritas para a seção. As novas espécies descritas apresentaram notável compatibilidade morfológica com a delimitação seccional proposta por Bas (1969) e Yang (1997), e todas, com exceção de *A. melliodora*, apresentaram esporos com dimensões bastante reduzidas (comprimento do esporo do 95º percentil ≤ 8.7), corroborando com o estudo de Tulloss (2005), que aponta a tendência de redução do tamanho espórico de *Amanita* (especialmente seção *Validae*) em áreas florestais de clima tropical.

Por fim, o presente trabalho representou um estudo preliminar de *Amanitaceae* para as áreas estudadas, cuja contribuição para ampliar o conhecimento da família no nordeste brasileiro foi significativa; apesar disso, é possível observar que esse conhecimento da diversidade ainda é bastante incipiente. Dada a importância econômica, ecológica e biotecnológica do grupo, estudos de biodiversidade em nível específico, acoplados aos estudos ecológicos, são prioritários para o país.

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APÊNDICE A – ARTIGO 01[1]

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[1] Artigo submetido para publicação na revista ‘CREAM’ (Current Research in Environmental & Applied Mycology)

Limacella brunneovenosa, a new species of *Limacella* sect. *Amanitellae* from Brazilian Atlantic Forest[1]

Limacella brunneovenosa, a new species of *Limacella* sect. *Amanitellae* from Brazilian Atlantic Forest

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Nascimento C. C. & Wartchow F. 2016: *Limacella brunneovenosa* (Amanitaceae : Agaricomycetidae : Basidiomycota), a new species of *Limacella* sect. *Amanitellae* from Brazilian Atlantic Forest. --- Ann. Bot. Fennici x: x--x.

Abstract

A new species of *Limacella* sect. *Amanitellae*, namely *L. brunneovenosa*, is described based on morphological and anatomical evidence. It is compared with similar species and illustrated with line drawings and photographs. This species was found in "Floresta Nacional Restinga de Cabedelo", an Atlantic Forest protected area located in the municipality of Cabedelo, State of Paraíba, Brazil. In addition, we present a list and some remarks about Central and South American species of *Limacella*.

1. Introduction

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[1] Artigo submetido para publicação na revista 'CREAM' (Current Research in Environmental & Applied Mycology)

Limacella Earle is an uncommon genus of Agaricales, probably worldwide (Kirk *et al.* 2008). Its comprises ca. 50 named taxa, although most of them involve inconsistent and poorly described reports, placing therefore the current state of knowledge of the genus in a chaotic situation (Tulloss & Yang 2017). The noteworthy papers about morpho-taxonomy and molecular phylogeny involving *Limacella* species have been useful for its macroscopical recognition and support inside the family Amanitaceae (Reijnders 1979, Komorowska 1984, Singer 1986, Ridley 1993, Gminder 1994, Moncalvo *et al.* 2000, 2002, Yang & Chou 2002, Kibby 2004, Bhatt *et al.* 2003, Neville & Poumarat 2004, Smith 2007, Ferreira *et al.* 2013).

Traditionally, the genus has been recognized by the following combination of characters: pileus slightly viscid or glutinous, without universal veil remnants; epicutis consisting of variously transformed or unchanged terminal members of hyphae which are ascendant or erect in a gelatinous mass; lamellae free or nearly so; lamellar-edge fertile; hymenophoral trama bilateral with divergent lateral strata; spore print white to cream; basidiospores globose to short ellipsoid, inamyloid, rarely dextrinoid, acyanophilous; stipe dry or viscid; partial veil present either as a glutinous layer or as a membranous annulus; not ectomycorrhizal (Singer 1986, Neville & Poumarat 2004). However, Tulloss & Yang (2017) emphasizes that in the most noteworthy characterizations for *Limacella* some characters are stated in vague ways, while others are based on probable misunderstandings of tissue ontogeny and the analogous relationships between tissues in *Amanita* and *Limacella* or are mentioned, but ignored in the taxonomy of the genus.

In order to diminish the use and influence of the diffuse, confusing characterizations that have been common up to the present, Tulloss *et al.* (2016) provide a concise characterization for *Limacella.* In this sense, a species of the Amanitaceae is a member of the genus *Limacella* if and only if it has both (1) an agaricoid basidiome not produced by schizohymenial ontogeny and (2) a fertile lamella margin and a gluten bearing cap with gluten held in place by anticlinally oriented elements.

The infrageneric arrangement proposed by Singer (1986) divided *Limacella* into two sections based mainly on the viscosity of the stipe: sect. *Lubricae* and sect. *Limacella* [= *Viscidae* (Smith 1945)]. Sect. *Lubricae* includes taxa with a viscid or glutinous stipe, whereas taxa in sect. *Limacella* have a dry stipe. Later, studying the morphological and ecological characters of European species of *Limacella*, Gminder (1994) described sect. *Amanitellae* to accommodate *L. guttata* (Pers.) Konrad & Maubl and its allies. This is the most clearly defined of the three sections, including those species of the genus that (1) have many terminal cells of gluten-supporting hyphae which are conic or subconic, and (2) with such terminal cells frequently having a subtending cell, or subtending short chain of cells, that is/are inflated (globose, subglobose, broadly ellipsoid, or other) (Gminder 1994, Tulloss & Yang 2017).

The genus has been mainly recorded in Europe and North America, with little information for the Southern Hemisphere, especially from the Neotropics (Neville & Poumarat 2004; Ferreira *et al.* 2013). Murrill (1911) was the first author to describe a species of *Limacella* from Central and South America. Since then, few publications **(**see Tab. 1) have contributed to our knowledge of this genus in this region.

The aim of the present contribution is to propose a new species within section *Amanitellae*, named *Limacella brunneovenosa*. It was found in a remnant area of Atlantic Forest in Brazilian Northeast and represents the first new species of *Limacella* described from South America. In addition, we present a list and some remarks about Central and South America species of *Limacella*.

2. Materials and Methods

The new species was collected at the “Floresta Nacional Restinga de Cabedelo”, an Atlantic Forest protected area of about 100 ha, located in the municipality of Cabedelo, State of Paraíba, Brazil. The area comprises a ‘restinga’ forest, with 160 species of angiosperms belonging to 61 families, of which the most diverse are *Myrtaceae*, *Leguminosae* (all subfamilies), *Rubiaceae*, *Poaceae* and *Euphorbiaceae* (Pontes & Barbosa 2008).

Macromorphological descriptions are based on field notes and color photographs of basidiomata taken in the field. Color codes are according to Kelly-K (1965) and Online Auction Color Chart-OAC (2004). Observations and measurements reported for micromorphological features were from dried material rehydrated and mounted in distilled water, 3% KOH and Congo red or Melzer's reagent. Biometric values and notation follow Tulloss *et al.* (1992) and Tulloss (1993, 1994, 1998, 2000), which is summarized below.

At the beginning of a set of spore data, the abbreviation [*a/b/c*] signifies "*a*" basidiospores measured from "*b*" basidiomata of "*c*" collections. Dimentions of basidiospores are presented in the following form (*m*--) *n*--*o* (--*p*), in which "*m*" is the smallest value observed or calculated and "*p*" is the largest value observed or calculated. In the range of values observed or calculated, the 5th percentile is "*n*"; and the 95th percentile is "*o*". A summary of definitions of biometric variables follows:

w_{cs} = breadth of central stratum of lamella;

w_{st}-near = distance from one side of central stratum to nearest base of basidium;
w_{st}-far = distance from one side of central stratum to the most distant base of basidium on the same side of central stratum;
L, (*W*) = the range of average lengths (widths) of spores of each basidioma examined;
L', (*W'*) = the average of all lengths (widths) of spores measured;
Q = the ratio of length to width of a spore or the range of such ratios for all spores measured;
Q = the average of *Q* computed for all basidiomata examined;
Q' = the average of all *Q* values computed for all spores measured.

The type has been lodged in the mycological collection of JPB (Thiers, continuously updated).

3. Taxonomy

Limacella brunneovenosa C.C. Nascimento & Wartchow, sp. nov. (Figs. 1--3)
MycoBank no.: MB 819451

Type: Brazil, Paraíba, Cabedelo, Floresta Nacional Restinga de Cabedelo, Mata da AMEM, 12 July 2012, *F. Wartchow 119/2012* (JPB 62772, holotype).

Etymology: From Latim: '*brunneo'* (= brown) and *'venosa'* (= veins); referring to the brownish veins embossing the pileus surface of the new species.

Basidiomes small, growing in pairs adhered by the stipe base. Pileus 26--39 mm diam., cream buff (K 73.p.oy; OAC 759), with radial brownish (K 72.d.oy; OAC 748) veins, which are paler (K 73.p.oy; OAC 759) at spotted margin, sub-globose to hemispherical, becoming convex; surface smooth, somewhat glutinous, becoming dry, with adhering soil particles; margin entire, non-striate, non-appendiculate and exceeding lamellae; context stuffed, whitish, unchanging, to 8 mm thick above stem. Lamellae free to slightly adnexed, pale cream (K 89.p.y; OAC 815), subclose to subdistant, ventricose to subventricose, to 5 mm broad; lamellulae attenuate, fairly abundant, with several lengths, evenly distributed; edge entire, concolorous with lamellae. Stipe 30--38 × 3.5--5 mm, solid, subcylindrical, slightly tapering upwards, dry, rather fragile, central to slightly excentric; base slightly inflated and curved to one side (within substrate), with white rhizomorphs; surface white to whitish, with scattered, easily detatched, cream buff

(K 76.I.yBr) squamules over almost all length; context fibrous, whitish, to 4.0 mm thick, unchanging. Partial veil fragile, easily broken, superior or apical, cream buff (K 76.I.yBr). Odour sweet fruit. Taste not recorded. Spore print not obtained.

Basidiospores [60/2/1] (4.0--)4.3--6.0(--6.5) × (3.9--)4.3--5.5(--6.5) µm [L = 4.9 --5.5 µm; L' = 5,2 µm; W = 4.6--5.1 µm; W' = 4.9 µm; Q = (1.00--) 1.02--1.15(--1.17); $\mathbf{Q}$ = 1.06--1.07; $\mathbf{Q'}$ = 1.06], globose to subglobose, rarely broadly ellipsoid, hyaline, inamyloid, smooth, thin-walled, contents granular to multiguttulate; apiculus sublateral to subapical, cylindric, often proportionately long-cylindric. Basidia 15--25 × 4.5--7 µm, clavate with abundant contents, 4-spored, occasionally 2- or 3-spored, with sterigmata to 2--3 µm. Lamellar trama bilateral, slightly divergent, hyaline, with a prominent mediostratum, with sparse oleiferous hyphae, up to 8 µm wide; mediostratum of dominant thin-walled inflated elements, up to 60 × 18 µm, filamentous hyphae infrequent 3--6 µm wide; w_{cs} = 30--35 µm; lateral stratum composed of divergent inflated, somewhat clavate elements (to 27 µm wide) and filamentous hyphae, 4--7 µm wide. Subhymenium cellular, to 30 µm thick, of 2--3 layers of more or less isodiametric to slightly irregular cells, 8.5--15(--18) × 7.5--12.5(--16) µm; w_{st}-near = 17.5--34, w_{st}-far = 36.5--45.5. Cheilocystidia and pleurocystidia absent. Lamellar edge fertile. Hyphae supporting voval gluten erect (or almost so), hyaline, with tapering (sometimes sinuous) terminal elements, 50--80 × 4--11.5 µm, embedded in a gelatinous matrix, arising from subtending chains of more or less isodiametric cells, 34--43.7 (--50) × 28.5--40.5 µm. Pileus context of hyaline, undifferentiated filamentous hyphae, to 7 µm wide, sometimes inflating to 16--19 µm wide. Stipitipellis not differentiated. Stipe context longitudinally acrophysalidic; acrophysalides 120--190 × 9.5--15 µm very slender clavate; filamentous hyphae 2--6.5 µm wide, abundant, hyaline, septa often clamped; oleiferous hyphae up to 7 µm wide, locally conspicuous to abundant. Clamp connections common in all tissues examined.

Habitat: Growing in pairs connate at the base, on sandy soil in ‘restinga’ vegetation Atlantic Forest.

Distribution: Presently known only from type locality (South America: Brazil, Paraíba State).

Extralimital material examined: (*L. ochraceolutea*) Brazil, Paraná, Palotina, Parque Estadual São Camilo, 19 november 2011, A.J. Ferreira 27/7 (HCP, JPB).

Notes: *Limacella brunneovenosa* is well circumscribed in the field by the cream buff, somewhat glutinous but soon drying pileus with radially arranged brownish veins, pale cream hymenophore, a dry stipe with scattered squamules, and presence of a fragile and easily broken annulus. Its main microscopic features can be summarized by (1) globose to subglobose, rarely broadly ellipsoid, smooth, thin-walled, inamyloid basidiospores [(4--)4.3--6(--6.5) × (3.9--)4.3--5.5(--6.5) µm], (2) cellular subhymenium, composed of 2--3 layers of more or less isodiametric to slightly irregular cells [8.5--15(--18) × 7.5--12.5(--16) µm]; and (3) hyphae supporting the voval gluten erect (or almost so), hyaline, with conic to subconic (sometimes sinuous) terminal elements (50--80 × 4--11.5 µm), arising from conspicuous subtending chains of more or less isodiametric cells and (6) common presence of clamps at the basal septa of basidia.

On account of the overall features in the gluten-supporting layer, which includes conic to subconic terminal cells and subtending chains of more or less isodiametric elements, this new species is best placed in sect. *Amanitellae* (Gminder 1994, Tulloss & Yang 2015). Within this section, the type species *Limacella guttata* (Pers.) Konrad & Maubl. represents an uncommon agaric with a widespread distribution throughout the Europe and North America (Smith 1945, Gminder 1994, Kibby 2004, Neville & Poumarat 2004). It differs from *L. brunneovenosa* by its larger sized basidiomata [pileus (40--)70--120(--150) mm wide, stipe 70--150 × 10--25 mm]; ochraceous cream to pinkish beige, umbonate pileus; lack of veins on pileus surface; fribrillose to finely fribrillose stipe surface; bulb clavate or with rather distinct knob and a membranous, ample, persistent partial veil, often covered above with small viscid exuded droplets (Gminder 1994, Neville & Poumarat 2004). Although there are no detailed descriptions of the microanatomy from the descriptions provided by Gminder (1994) and Neville & Poumarat (2004), *L. guttata* can be distinguished from *L. brunneovenosa* by its shorter/narrower terminal cells of gluten-suppoting hyphae [17--43 × 3.5--6 µm (at base) × 1.5--3 (at apex)].

Limacella myochroa Pegler and *Limacella solidipes* (Peck) H.V. Sm. are other species in sect. *Amanitellae* that can be compared to *L. brunneovenosa*. *Limacella myochroa* described from Martinique (Pegler 1983) has similar globose to subglobose basidiospores (5--6 × 4--5 µm; **Q'** = 1.16), but has a gray-brown (or brown-gray) pileus with a slightly striate margin and a persistent, membranous partial veil. *Limacella solidipes* described from New York – USA (Smith 1945) is most similar to *L. brunneovenosa*. Both taxa have globose to subglobose, sometimes broadly ellipsoid basidiospores (4--5 × 4--5 µm, Q = 1.0--1.25) and erect hyphae of the gluten-supporting layer, which have a distinctive rather blunt-pointed end cells. However, *L. solidipes* has small to medium-sized basidiomata (cap 30--70 mm broad, stipe 80--100 × 6--10 mm) with a "pale pinkish buff" (very pale alutaceous) pileus surface; crowded lamellae; never scaly stipe and a persistent, ample, pendulous partial veil (Smith 1945). In *Limacella brunneovenosa* basidiomata are smaller, with a cream buff pileus; subclose to subdistant lamellae; scaly stipe and an inconspicuous, evanescent partial veil

4. Discussion on distribution of *Limacella* from Central and South America

To date, including *L. brunneovenosa*, only nine species of *Limacella* are known from Central and South America (Tab. 1).

Amongst these, *L. agricola* and *L. alachuana* are problematic taxa. The first remain as an 'insufficiently known' species according Tulloss & Yang (2017). It was only recorded from the type locality in Jamaica by Murrill (1911), and no information is available on the important anatomical features, which are mandatory in order to determine its relationships. The latter species was described originally from Florida, USA (Murrill 1938), and subsequently reported from Martinique by Pegler (1983) as a new combined taxon (within *Limacella* sect. *Lubricae*). However, Pegler's determination has been questioned (Tulloss & Yang 2015), since it did not involve a revision of the type collection and even overall features described by him, such as pigments from pileus and lamellae, differ from those in the Murrill's protologue (Murrill 1938).

Four taxa of *Limacell*a are believed to occur in Brazil (Tab. 1). Three, namely *L. illinita*, *L. glischra* and *L. guttata,* are known only from checklists of agarics (Bononi 1984, Pegler 1997, Meijer 2006) so their status cannot be verified as there are no comments on macro- and microcharacters, no mentions about available specimens in herbarium. The only reliable species of *Limacella* so far reported from Brazilian territory seems to be *L. ochraceolutea,* occurring on woodland soil among fallen leaves of palm *Syagrus romanzoffianum* in Paraná State, South Brazil (Ferreira et al. 2013). It is the only fully described *Limacella* species for Central and South America using methodology that benefits from the advances in Amanitaceae studies since Corner & Bas (1962) and Bas (1969), therefore it represents an important source of comparison for subsequent studies (morphological comparison and/or molecular analysis) for *Limacella* species in Neotropical Brazil.

In conclusion, the listed species of *Limacella* for Central and South America should be regarded with caution, since most of them are incomplete or unsubstantiated reports. Moreover, the results of this paper strongly support the necessity of collecting and studying *Limacella* especially in Central and South America because very little is known about its Neotropical species.

Acknowledgments

The authors wish to thank the 'Conselho Nacional de Desenvolvimento Científico e Tecnológico' (CNPq) for providing funds for the 'Programa de Pesquisa em Biodiversidade'/PPBio (CNPq/MCT Proc. 60/2009), ICMBio (SISBIO Proc. 32199-4) for authorized collection trips, INCT Herbário Virtual da Flora e dos Fungos (Proc. 573883/2008-4) and Sisbiota (Proc. 371493/2012-9). We also thank Felipe Pinheiro for collecting material and Dr. Maria Regina Barbosa and TAXON Laboratory for the facilities provided.

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Tabela 1 - Taxa of *Limacella* recorded from Central and South America, country distribution and Reference list.

Species	Country Distribution	References
Limacella agricola Murrill	Jamaica	Murrill (1911); Smith (1945)
Limacella alachuana (Murrill) Pegler	Martinique	Pegler (1983)
Limacella glischra (Morgan) Murrill	Brazil	Bononi (1984)
Limacella guttata (Pers.) Konrad & Maubl.	Brazil, Martinique	Pegler (1983, 1997); Meijer (2006)
Limacella illinita (Fr.) Maire	Antigua, Brazil, Martinique	Pegler (1983); Meijer (2006)
Limacella laeviceps (Speg.) Raithelh.	Argentina, Uruguay	Spegazzini (1899, 1926); Farr (1973); Raithelhuber (1974, 1987, 1991, 2004)
Limacella myochroa Pegler	Martinique	Pegler (1983)
Limacella ochraceolutea P.D. Orton	Brazil	Ferreira et al (2013)
Limacella brunneovenosa C.C. Nascimento & Wartchow	Brazil	This paper

Figura 1 - *Limacella brunneovenosa*. **(A)** Basidiomes (bar 10 mm). **(B)** Basidiospores (bar 5 µm). **(C)** Terminal elements of gluten-supporting hyphae (bar 10 µm). **(D)** Subhymenium, basidia and basidioles (bar 5 µm). Drawings: Rhudson f. Cruz.

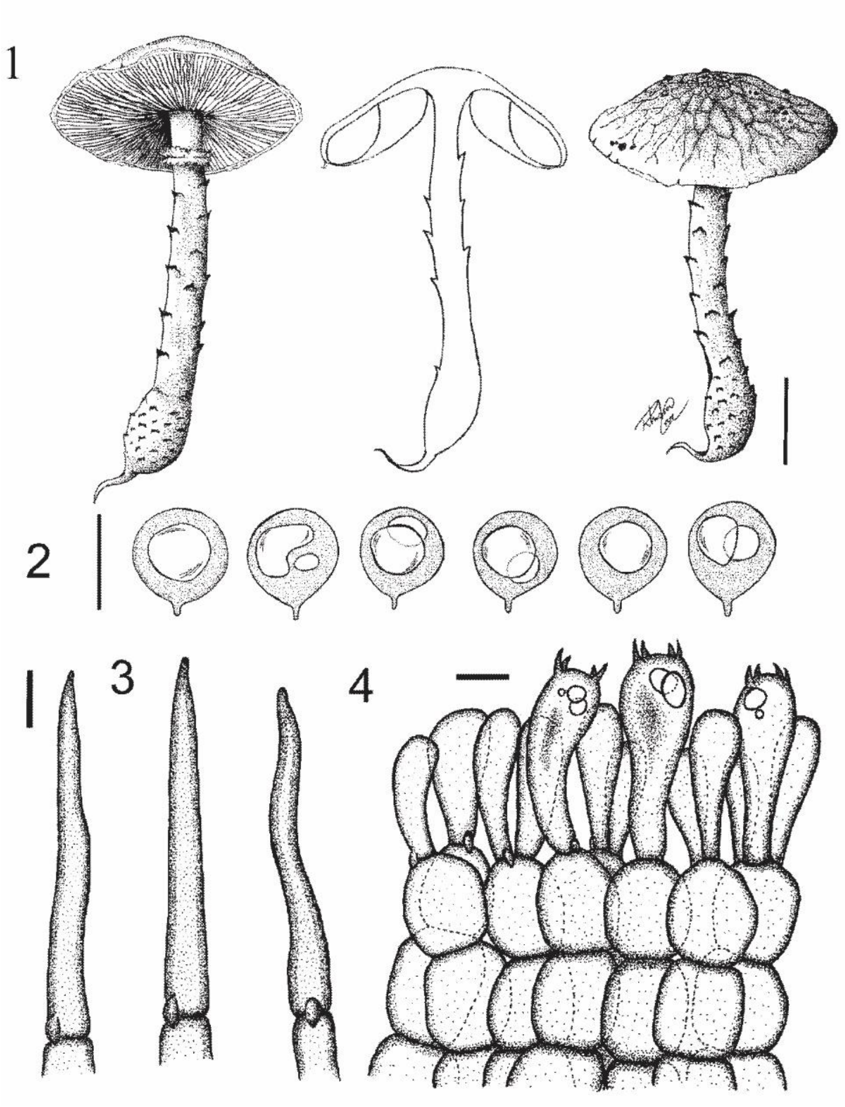


Figura 2 - *Limacella brunneovenosa*. (A) Gluten-supporting hyphae (bar 20 µm): a gelatinized matrix; b subtending cells. Drawing: Rhudson f. Cruz.

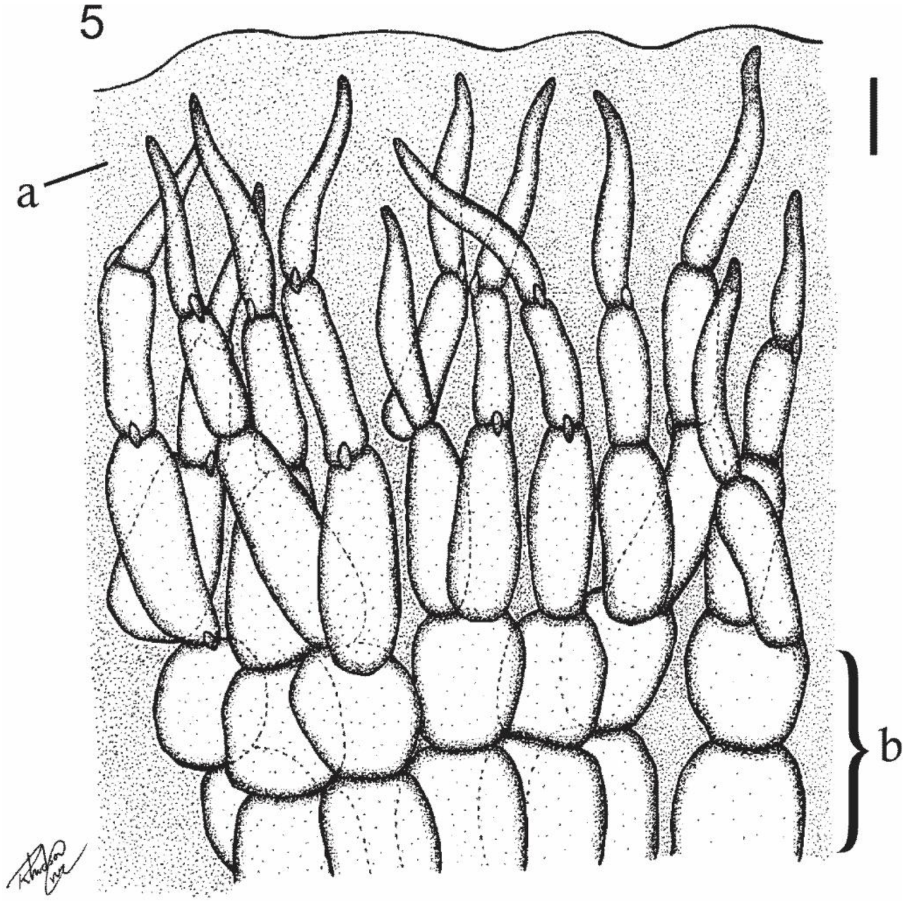
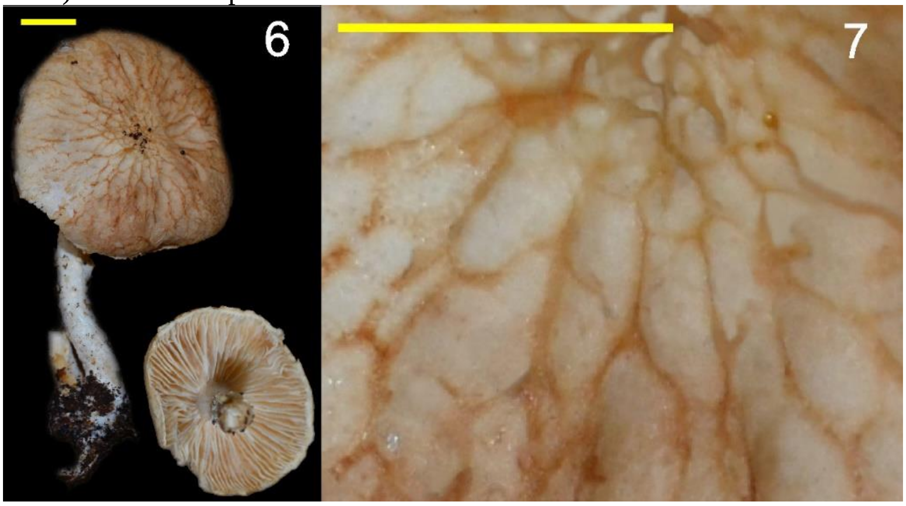
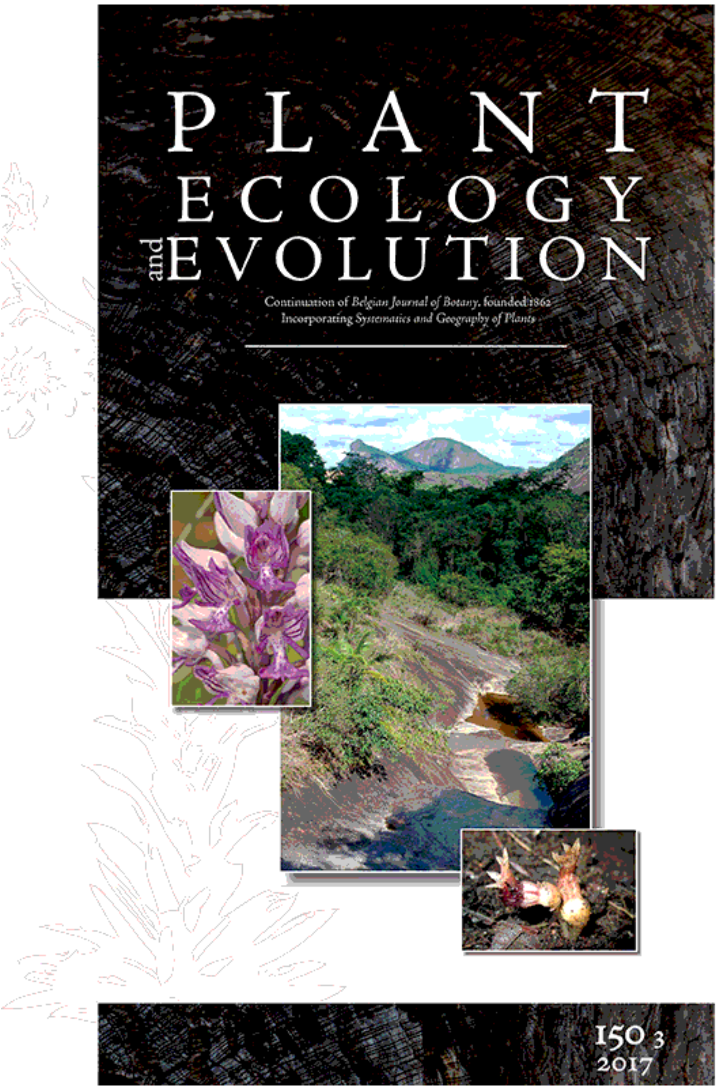


Figura 3 - *Limacella brunneovenosa*. (A) Basidiomes (bar 10 mm). (B) Venous pattern on pileus surface (bar 5 mm). Photos: Felipe Wartchow.



APÊNDICE B - ARTIGO 02[1]



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Short title: A new *Amanita* from Northeast Brazil

Amanita dulciodora **(Amanitaceae, Basidiomycota), a striking new species of** ***Amanita*** **section** ***Lepidella*** **from Northeast Brazil**

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Background – *Amanita* Pers. has a worldwide distribution and is one of the most well-known fungal genera in terms of both morphotaxonomy and molecular phylogenetics, consisting of many edible, as well as poisonous, even lethal, mushrooms. The genus is also known to form ectomycorrhizal associations with angiosperms and gymnosperms and play an important role in ecosystems**.** Although previous studies have already pointed out the high diversity of the genus *Amanita* in tropical areas, only a few recent studies continue to record and/or describe new species of *Amanita* from Brazilian territory. Herein, an additional, morphologically striking new species of *Amanita* sect. *Lepidella* is described from Northeast Brazil.

Methods – The new species was collected at 'Parque Estadual Serra do Conduru' (PESC), located in the municipalities of Uruçuca, Itacaré and Ilhéus, Bahia state. The park is an Atlantic Forest protected area with about 7000 ha in a region with a high degree of endemism. For morphological analysis, standard methods for *Amanita* were followed.

Key results – *Amanita dulciodora* is described as new species from Atlantic Forest remnants in southeast Bahia. It is assignable to *Amanita* stirps *Crassiconus* within *Amanita* subsect. *Solitariae* and is mainly characterized by its (1) medium-size basidiomata with cap color and appearance dominated by universal veil at first; (2) distinctly colored acute-pyramidal, truncate-pyramydal to verrucose warts which are mainly composed of irregularly disposed, ovoid to subglobose to clavate cells intermixed with very abundant filamentous hyphae; (3) mostly ellipsoid to elongate amyloid basidiospores and (4) the common presence of clamps at the basal septa of basidia. It was compared with its similar species, *A. crassiconus* and illustrated with line drawings and photographs.

Keywords – Agaricales, Agaricomycetes, Fungi, neotropics, taxonomy

INTRODUCTION

Amanita Pers. has a worldwide distribution and is one of the most well-known fungal genera in terms of both morphotaxonomy and molecular phylogenetics, consisting of many edible, as well as poisonous, even lethal, mushrooms (Weiß et al. 1998, Drehmel et al. 1999, Tulloss 2005, Letcher 2007, Cai et al. 2014, 2016). It comprises primarily agaricoid and a few sequestrate forms (Moncalvo et al. 2002, Justo et al. 2010, Yang 2011). The genus is also known to form ectomycorrhizal associations with angiosperms and gymnosperms and play an important role in ecosystems (Yang et al. 1999, Yang 2005, Wolfe et al. 2012b). Although most species of *Amanita* are symbiotic, a small number of species consistently grow apart from woody plant hosts as saprobes or, at least amycorrhizal organisms (e.g. *A. thiersii* Bas, *A. inopinata* D.A. Reid & Bas) (Bas 1969, Wolfe et al. 2012a, Hess & Pringle 2014). *Amanita* comprises ca. 500 described species (Bas 2000, Tulloss 2005), but this number can be increase to more than 900 names if counting undescribed species (Tulloss & Yang 2018). According the traditional infrageneric classifications based on morpho-anatomical features, *Amanita* was often divided into two subgenera, *Amanita* and *Lepidella* (E.-J Gilbert) Veselý emend. Corner & Bas (1962), comprising seven sections: sect. *Amanita*, sect. *Caesareae* Singer, sect. *Vaginatae* (Fr.) Quél., sect. *Amidella* (J.-E Gilbert) Veselý, sect. *Lepidella*, sect. *Phalloideae* (Fr.) Quél and sect. *Validae* (Fr.) Quél. This systematic division has been supported by several molecular phylogenetics works (Weiß et al. 1998, Drehmel et al. 1999, Zhang et al. 2004, Justo et al. 2010, Cai et al. 2014, Tang et al. 2015, Tulloss et al. 2016).

Previous studies have already pointed out the extent of diversity in the genus *Amanita* in tropical areas (Pegler 1983, 1986, Tulloss et al. 1992, 2011, Bas & de Meijer 1993, Tulloss 2005, Tulloss & Franco-Molano 2008, Simmons et al. 2002, Tang et al. 2015). Rick (1906), Rick (1937), Singer (1953), Homrich (1965), Bas (1978), Grandi et al. (1984), Capelari & Maziero (1988), Bas & de Meijer (1993), Stijve & de Meijer (1993), Pegler (1997), Giachini et al. (2000), de Meijer (2001, 2006), Sobestiansky (2005) and some more recent studies by Wartchow & Maia (2007), Wartchow et al. (2007, 2009, 2013a, 2013b, 2015a, 2015b), Menolli et al. (2009a, 2009b) and Wartchow (2015, 2016) have recorded and/or described new species of *Amanita* from Brazilian territory.

The aim of the present study is to contribute to the knowledge of *Amanita* mycobiota by describing a new species from sect. *Lepidella* collected in Atlantic Forest remnants of Northeast Brazil. In addition we present a dichotomous key to Central and South America species of the section.

MATERIAL AND METHODS

Material and collection localities

The ‘Parque Estadual Serra do Conduru’ (PESC) is located on the territory of three municipalities: Uruçuca, Itacaré and Ilhéus (14º23′07″ S and 39º04′43″ W), Bahia state, in the northeast of Brazil. The park has approximately 7000 ha (Angelo 2003). The climate is described as tropical humid, with mean annual temperatures close to 24º C. Average annual precipitation is over 1,300 mm, with higher rainfall occurring from February to July (Sá et al. 1982). The vegetation is characterized by the Dense Ombrophilous Forest within the Atlantic Forest biome. It has a high potential for biodiversity conservation with about 458 tree species per hectare, as well as high rates of endemism. It represents one of the most important blocks of forest remnants of the northeastern coast (Mori et al., 1983, Thomas et al., 1998).

Morphological studies

Macromorphological descriptions were based on notes and color photographs of basidiomata taken in the field. Colors of fresh and dry basidiomes were compared with reference colors in Kornerup and Wanscher (1978). Observations and measurements reported for micromorphological features were obtained from dried material rehydrated and mounted in distilled water, 3% KOH and Congo red or Melzer's reagent. Regarding biometric values and notation, we follow the emended methodology of Tulloss et al. (1992) and Tulloss (1993, 1994, 2000), which is summarized below.

At the beginning of a set of spore data, the abbreviation [*a/b/c*] signifies "*a*" basidiospores measured from "*b*" basidiomata of "*c*" collections. Dimensions of basidiospores are presented in the following form *(m--) n--o (--p),* in which "*m*" is the smallest value observed or calculated and "*p*" is the largest value observed or calculated. In the range of values observed or calculated, the 5th percentile is "*n*"; and the 95th percentile is "*o*". A summary of definitions of biometric variables follows:

L, (**W**) = the range of average lengths (widths) of spores of all basidioma examined.

L’, (**W’**) = the average of all lengths (widths) of all spores measured.

Q = the ratio of length to width of a spore or the range of such ratios for all spores measured.

Q = the average of Q computed for all basidiomata examined.

Q’ = the average of all Q values computed for all spores measured.

The holotype is kept at the mycological collection of JPB (Thiers 2018).

SPECIES DESCRIPTION

Amanita dulciodora C.C. Nascimento, Sá & Wartchow, **sp. nov.**

MycoBank # MB 824182

Diagnosis -- Basidiomes medium-sized. Pileus 86--96 mm wide, white to whitish, unchanging; *universal veil* as pastel red to reddish orange to yellowish red pyramidal warts; lamellae white, orange white or pinkish white to somewhat cream color, unchanging; lamellulae truncate; stipe white to whitish; bulb napiform at maturity, 35--37 mm long and up to 27 mm wide; basidiospores (7.1--) 7.9--10.7 (--11.7) × (4.6--) 4.8--6.1 (--6.2) µm, ellipsoid to elongate then infrequently cylindric, amyloid; basidia clamped.

Holotype: Brazil, Bahia, Uruçuca, Parque Estadual da Serra do Conduru, 29 Nov 2012, *F. Wartchow et al*. FW 143/2012 (JPB 60534). Figs. 1 & 2.

Etymology -- From Lat., ‘*dulcis*’ (= sweet) and ‘*-odorus*’ (= “having a smell”). Regarding to sweetish smell exhaled by the fungus.

Macroscopic characters -- Basidiomes medium-sized, solitary. **Pileus** 86--96 mm wide, cap color and appearance dominated by universal veil at first, later with exposed surface white (1A1) to whitish (2A1), unchanging, globose at first, subhemispheric to hemispheric when expanding, then convex to applanate at maturity, dry; *margin* incurved when expanding, straight at maturity, non-striate, often strongly appendiculate with flocculence from universal veil on marginal region and with ephemeral bits of partial veil (concolorous and irregularly shaped); *context* up to 11 mm thick at stipe, firm, white to whitish except pale gray (1B1) to pastel gray (1C1) just beneath pileipellis, unchanging when cut or bruised, gradually thinning toward margin; *universal veil* as concentrically arranged, acute-pyramidal, truncate-pyramidal to verrucose, coarse adnate warts, up to 1.5--3 (--4) mm high, 1--2.5 (--3) wide, densely placed over the disk, towards margin becoming low amorphous flocculence to flat fibrillose scales, pastel red (7A4, 8A4) to reddish orange (7A5--6) to yellowish red (8A5--6). **Lamellae** subfree to free, with short decurrent tooth at stipe apex, subcrowded to crowded, white (1A1), orange white (6A2) or pinkish white (7A2) to somewhat cream color (4A3), unchanging when cut or bruised, with edges smooth and concolorous, often with partial veil remnants attached, up to 6 mm wide (at mid-radius; *lamellulae* mostly truncate, with 3--4 lengths, plentiful, unevenly distributed. **Stipe** 48--55 (excluding bulb) × 17--19 (--23) mm (at mid-stipe), slightly tapering upward, flaring at apex, smooth, white to whitish, becoming yellowish to brownish yellow (5C8) or yellow ochre (5C7) from handling; *bulb* at first turbinate to elongate, then napiform, 35--37 mm long and up to 27 mm wide, ventricose, sometimes doglegged, deeply inserted into the substrate; *context* solid, bulb hollow in only one basidiome (probably ate by insects), whitish, unchanging when cut or bruised; *partial veil* as apical to superior pulverulent belt at stipe, off-white, rather fragile, ephemeral, remaining as appendiculate material at pileus margin; *universal veil on stipe base* leaving subconical to irregular warts, reddish orange (7A5--6) to yellowish red (8A5--6) at first, becoming reddish (or pinkish) white (7A2, 8A2) to shell pink (8A3), arranged in incomplete belts on upper bulb and lower stipe. **Odor** very sweet (remarkable). **Taste** not recorded.**Macrochemical tests** not performed.

Microscopic characters -- Basidiospores [90/3/2] (7.1--) 7.9--10.7 (--11.7) × (4.6--) 4.8--6.1 (--6.2) µm; **L** = 9.1--9.2 µm; **L’** = 9.2 µm; **W** = 5.2--5.6 µm; **W’** = 5.4 µm; Q = (1.39--) 1.46--2.09 (--2.22); **Q** = 1.72--1.73; **Q’**= 1.72; ellipsoid to elongate, infrequently cylindric, hyaline, colorless, amyloid, thin-walled; *contents* as 1--2 guttules; *hilar appendix* prominent, sublateral. **Basidia** (30--) 34--60 × 8.5--12 (--14.5) µm, thin-walled or nearly so, mostly 4-, rarely 2-spored, with sterigmata up to 8 µm; basal septa commonly clamped. **Subhymenium** up to 50 µm thick, with (2) 3--4 layers of subglobose to ovoid or irregularly shaped cells 9--25 (--30) × 8--20, often mixed with a few, short, un- or partially inflated hyphal segments, with basidia arising from elements of all types; clamp connections frequent. **Lamellar trama** bilateral, divergent; central stratum 40—50 µm wide, composed of some intercalary partially inflated to narrowly ventricose cells 140 × 19 µm, mixed with branched, interwoven filamentous undifferentiated hyphae 3--12 µm wide; vascular hyphae 2.3--8.5 µm wide, infrequently branched, sinuous, rare; lateral stratum made up of diverging (at angles up to 45º), filamentous, undifferentiated hyphae 3--14.5 µm wide, branched, mixed with broadly to narrowly clavate to sub-ellipsoidal inflated cells, apparently all intercalary; vascular hyphae 4.3--9.5 µm wide, rare; clamp connections frequent in subhymenial base. **Lamellar edge tissue** sterile; inflated cells 18--30 (--35) × 7--12 (--16) µm, colorless, thin-walled, subglobse to clavare, single or 2--3 in chain; filamentous hyphae abundant, 2--8 µm wide, thin-walled, hyaline. **Pileus context** with acrophysalides up to 22 × 14 µm, broadly clavate; filamentous hyphae 2.5--10 µm, plentiful, interwoven, commonly branched, septate, clamped; vascular hyphae not seen or lacking. **Pileipellis** as narrow cutis (30--70 µm thick) with pronounced boundaries, ungelatinized to minimally gelatinized (only at surface); filamentous undifferentiated hyphae 3.0--9.5 µm wide, densely packed vertically, branching, with many at and near upper surface connected to universal veil well into maturity; vascular hyphae 3.5--14.5 µm wide, branched, sinuous, scattered to locally conspicuous. **Universal veil on pileus** with rather abundant filamentous, undifferentiated hyphae (especially in the base of warts), with elements dominantly irregularly disposed (anticlinal arrangement of elements only distinct in the layer close to poorly formed pileipellis); elements of lower part of wart colorless to sub-colorless; elements of upper part orange-yellow to orange-brown in mass; filamentous, undifferentiated hyphae 3.5--17.5 µm wide, plentiful to locally dominant, thin- or sometimes slightly thick-walled (especially in hyphae segments of larger diameter, up to 0.8 µm thick), branched, sometimes with uninflated hyphal end segments, hyaline or with brownish vacuolar pigments; inflated cells abundant, mainly ovoid to subglobose (38--67 × 35--58 µm), broadly ellipsoid (45--70 × 30--40 µm) to clavate (sometimes slightly constricted, up to 90 × 49.5 µm), more rarely fusiform-ellipsoid, ventricose-fusiform, and elongate in shape, terminal singly or in chains of 2--3 (--4), thin- to slightly thick-walled (up to 1.0 µm), usually with brownish to yellowish vacuolar pigments, sometimes colorless to sub-colorless; vascular hyphae scattered to locally conspicuous 3--13.5 µm wide. **Universal veil on upper part of bulb** with a structure very similar to that of the universal veil on pileus, with greater proportion of filamentous, undifferentiated hyphae; inflated cells smaller (on average) than on pileus; inflated cells. **Stipe context** distinctly vertically acrophysalidic; acrophysalides 180--200 × 20--36 µm, plentiful, very conspicuous, clavate; filamentous hyphae 4--8 µm wide, longitudinally oriented, frequently branched, septate, clamped; vascular hyphae up to 5 µm wide, unbranched, rare. **Partial veil** filamentous, undifferentiated hyphae 2--12.5 µm wide, fairly abundant, hyaline; inflated cells plentiful, ovoid to subglobose to broadly clavate, up to 85 × 38 µm, terminal, usually singly, dominantly colorless, hyaline, occasionally with yellowish walls; vascular hyphae not observed; clamp connections not observed.

Other collections examined -- Brazil: Bahia, Uruçuca, Parque Estadual da Serra do Conduru, 28 Nov. 2012, F. Wartchow et al. FW 134/2012 (JPB).

Habit and Habitat -- solitary, scattered or in pairs on clay soil in Dense Ombrophilous Forest (Atlantic rainforest biome), at ca. 300 m alt.

Known distribution -- Only known from the type locality.

Conservation status -- This species is only known from the type locality. No information is available on its population status, natural history or threats, and it is consequently listed as Data Deficient (IUCN 2001). The species might have a restricted range but further investigations of population trends and distribution are necessary for assessing its conservation status.

DISCUSSION

The longitudinally acrophysalidic stipe tissue, the bilateral, divergent lamella trama, and the sterile edges of the lamellae place the present species in the genus *Amanita*. The amyloid spores and the non-striate and strongly appendiculate pileus margin place this species in *A.* [subgen. *Lepidella* (E.-J. Gilbert) Veselý emend Corner & Bas] sect. *Lepidella*. Bas (1969: 345) provides a key to four subsections of sect. Lepidella. Of these, a non-membranous universal veil that never forms a persistent limb at the stipe base, but leaves on the pileus floccose warts that comprise irregularly disposed or vertically aligned inflated elements with common filamentous hyphae characterize taxa assigned to subsect. *Solitariae* Bas (1969). In this sense, *A. dulciodora* would appear to belong to stirps *Crassiconus* on account of the clamped basidia, the rarely cylindrical basidiospores, coloured latex absent, universal veil remnants on the pileus which are composed of irregularly disposed, inflated cells intermixed with abundant filamentous hyphae, the conical adnate, distinct dark coloured (although not greyish) warts on pileus (Bas 1969: 386-389).

The new species is well circumscribed by its (1) medium-size basidiomata with cap color and appearance dominated by universal veil at first; (2) distinctly colored acute-pyramidal, truncate-pyramidal to verrucose warts which are mainly composed of irregularly disposed, ovoid to subglobose to clavate cells intermixed with very abundant filamentous hyphae; (3) a bulbous stipe base with verrucose universal veil remnants arranged in incomplete belts; (4) an ephemeral partial veil made up of ovoid to subglobose to broadly clavate cells mixed with fairly abundant filamentous hyphae; (5) mostly ellipsoid to elongate amyloid basidiospores and (6) the common presence of clamps at the basal septa of basidia.

Actually, the only species that belongs to stirps *Crassiconus* is *A. crassiconus* Bas nom. prov. It was found in West Africa (Nigeria), and indeed, exhibits the closest similarity to *A.*

dulciodora. Both taxa share (1) a whitish pileus with conspicuous adnate volval remnants composed of irregularly disposed, mainly subglobose to ellipsoid cells mixed with abundant filamentous hyphae and (2) clamped basidia. But some important morphological and anatomical differences in basidiome can segregate *A. crassiconus* from *A. dulciodora*.

Regarding the morphologial features, *A. crassiconus* generally has greyish (probable pale grey) warts on cap; a pileus margin with some scattered, crust-like patches; minutely flocculose edged lamellae; universal veil remnants on lower stipe and upper bulb as thin, felted, incomplete, brownish-grayish girdles that disappear with aging; a clavate-fusiform bulb (30--40 × 15--25 mm). While in *A. dulciodora* the warts on pileus are pastel red to reddish orange to yellowish red, occurring at the margin as amorphous flocks to flat fibrillose scales, never as crust-like patches; lamellar edge is always smooth; stipe base always bearing adnate warts of universal veil; the bulb is distinctly napiform at maturity (35--37 mm long and up to 27 mm wide). As for the anatomical features, *A. crassiconus* completely lacks a pileipellis, with volval material directly attached to the pileus context, while *A. dulciodora* has a clearly delimited (although narrow), ungelatinized to minimally gelatinized pileipellis; furthermore, *A. crassiconus* displays subglobose to ellipsoid basidiospores that measure (7.2--) 8.5--10.8 (--16.8) × (5.9--) 6.5--8.0 (--11.5) µm; Q = (1.13--) 1.19--1.43 (--1.46); **Q** = 1.25--1.35; **Q’** = 1.30 (Bas 1969), while those in *A. dulciodora* are somewhat smaller and range from ellipsoid to elongate (rarely cylindrical) with a distinctly higher Q value (7.1--) 7.9--10.7 (--11.7) × (4.6--) 4.8--6.1 (--6.2) µm; Q = (1.39--) 1.46--2.09 (--2.22); **Q** = 1.72--1.73; **Q’**= 1.72. Tulloss & Yang (2018) reported basidiospores of *A. crassiconus* as follow: [100/5/4] (7.2--) 8.5--10.8 (--16.8) × (5.9--) 6.5--8.0 (--11.5) µm, (**L** = 9.0--9.8 µm; **L’** = 9.4 µm; **W** = 7.1--7.4 µm; **W’** = 7.3 µm; Q = (1.13--) 1.19--1.43 (--1.46); **Q** = 1.25--1.35; **Q’** = 1.30).

Four other species assigned to section *Lepidella* namely *A. heishidingensis* Fang Li & Qing Cai, *A. macrocarpa* W. Q. Deng, T.H. Li & Zhu L. Yang, *A. perpasta* Corner & Bas, *A. sculpta* Corner & Bas and *A. strobilipes* Thongbai, Raspé & K.D. Hyde resemble superficially *A. dulciodora* and *A. crassiconus* in having always pigmented pyramidal/conical warts on the pileus surface. However, according to key elaborated by Bas (1969: 386-389) all of them are primarily segregate from taxa of stirps *Crassiconus* in the clampless basidia (Corner & Bas 1962, Bas 1969, Deng et al. 2014, Li & Cai 2014, Li et al. 2016, Tulloss & Yang 2018).

Key to species of *Amanita* section *Lepidella* from Central and South America

1. Universal veil on pileus consisting mainly of chains of relatively large, inflated, cylindrical, elongate-fusiform, and narrowly clavate cells. Remnants of universal veil on stipe scattered or more rarely concentrated locally or indistinct. ……………………………………………..….**2**

1'. Universal veil on pileus comprising disordered to more or less anticlinal elements, never as chains of relatively large, narrow inflated cells. Stipe usually with bulbous base and universal remnants concentrated below……………………………...….…………………**11**

2. Basidia with clamps………………………..........……………..……………....……….**3**

2'. Basidia clampless……………….…………………….……………………...……….….**10**

3. Basal bulb lacking or somewhat inconspicuous (narrowly clavate or narrowly fusiform or as a limited swelling in lower stipe.………………………………………….......... …...….**4**

3'. Stipe with a conspicuous napiform to subnapiform basal bulb………………………….....**9**

4. Pileus evenly dark brown to somewhat paler grayish brown with concolorous pyramidal warts………………...……………………...………….…………………...….***A. grallipes*** Bas & de Meijer

4'. Pileus surface whitish, cream color, light beige, pinkish beige, reddish beige, pale pinkish orange or pale ochraceous-buff ………………………………………….……………**5**

5. Universal veil remnants on stipe pulverulent-floccose and concentrated on upper part ………………………………………...……...…………………….........***A. nauseosa*** (Wakef.) D.A. Reid

5'. Universal veil remnants on stipe scattered, absent or as inconspicuous girdles on lower half, never pulverulent-floccose …………………………………………………….….**6**

6. Basidiospores length ≥ 10 µm (**L'** ≥ 11.0 µm)………………..……………........…..**7**

6'. Basidiospores length ≤ 10 µm (**L'** ≤ 9.1 µm)……………………...………………….**8**

7. Pileus surface white to pale pinkish orange, with a dense covering of small to large scales. Stipe not tapering downward..……………………...………...…..…...***A. ameghinoi*** (Speg.) Singer

7'. Pileus whitish to faintly brownish cream, with flat, roughly polygonal, thin warts or small patches. Stipe tapering downward and slightly rooting.………….......……***A. prairiicola*** Peck

8. Stipe completely white or whitish, densely covered with erect to recurved floccose warts, scales, or squamules ……..***A. lilloi*** Singer

8’. Stipe white, becoming dingy brownish with age, with universal veil remnants absent or as very inconspicuous, thin and narrow, incomplete girdles on lower half…........….***A. singer*** Bas

9. Pileus surface pale ochraceous, covered with adnate, small, pointed, felted, concolorous warts………………………………….…………………..…..……….……***A. bubalina*** Bas

9’. Pileus surface white to grayish brown with fine squamulose universal veil remnants, densest over disk, brown…………...…...……………………………….……….…***A. savannae*** Tulloss & Franco-Mol.

10. Pileus surface pale yellowish, covered with detersile, yellow to ochraceous brown to brownish floccose-squamulose remnants of universal veil. Stipe slightly narrowing upward, not bulbous..……………………………….…………………….……………..***A. aureofloccosa*** Bas

10’. Pileus surface white, sometimes with pinkish or yellowish tinge, with pulverulent-floccose to subfelted universal veil remnants in subpyramidal warts or patches. Stipe subcylindric, with a conspicuous bulb......................................……………...***A. foetens*** Singer

11. Pileus surface intensely colored (brown to brownish-gray or green to deep green). Basal bulb turnip shaped to carrot shaped, rooting…..……**12**

11’. Pileus surface white, at least at first or light ochraceous-buff with light orange stains or pale buff or grayish tan. Basal bulb rarely somewhat rooting………………………………..**13**

12. Pileus brown to brownish-gray. Stipe annulate……………...………..***A. costaricensis*** Tulloss, Halling, G.M. Muell. & Singer

12’. Pileus green to deep green. Stipe exannulate………......……..............….***A. viridissima*** Wartchow

13. Spores with **Q** > 1.45…………………………………….……………......……**14**

13’. Spores with **Q** < 1.45...**16**

14. Universal veil white to whitish………………………………….......………..…**15**

14’. Universal veil distinctly pigmented (pastel red to reddish orange to yellowish red)………………………………………………………………………….***A. dulciodora*** C.C. Nascimento, Sá & Wartchow

15. Universal veil on pileus adnate as thick, radially fibrillose, polygonate patches to truncate pyramidal warts with felted tips. Annulate...…***A. crassa*** Bas

15’. Universal veil on pileus detersile as fine pulverulence and/or small pyramidal warts becoming flocculence toward margin. Usually exannulate……………………..***A. polypyramis*** (Berk. & M.A. Curtis) Sacc.

16. Universal veil on stipe base often present as short thin limb and/or in incomplete rows of triangular flaps. Lamellae pale cream to slightly orangish yellow tan in mass, unchanging………………..……………………..…………………………………***A. conara*** Tulloss & Halling

16’. Universal veil remains on stipe base in series of obscure rings, never forming limb at upper part of bulb. Lamellae off-white than staining yellowish to cinnamon…..…….***A. advena*** Tulloss, Ovrebo & Halling

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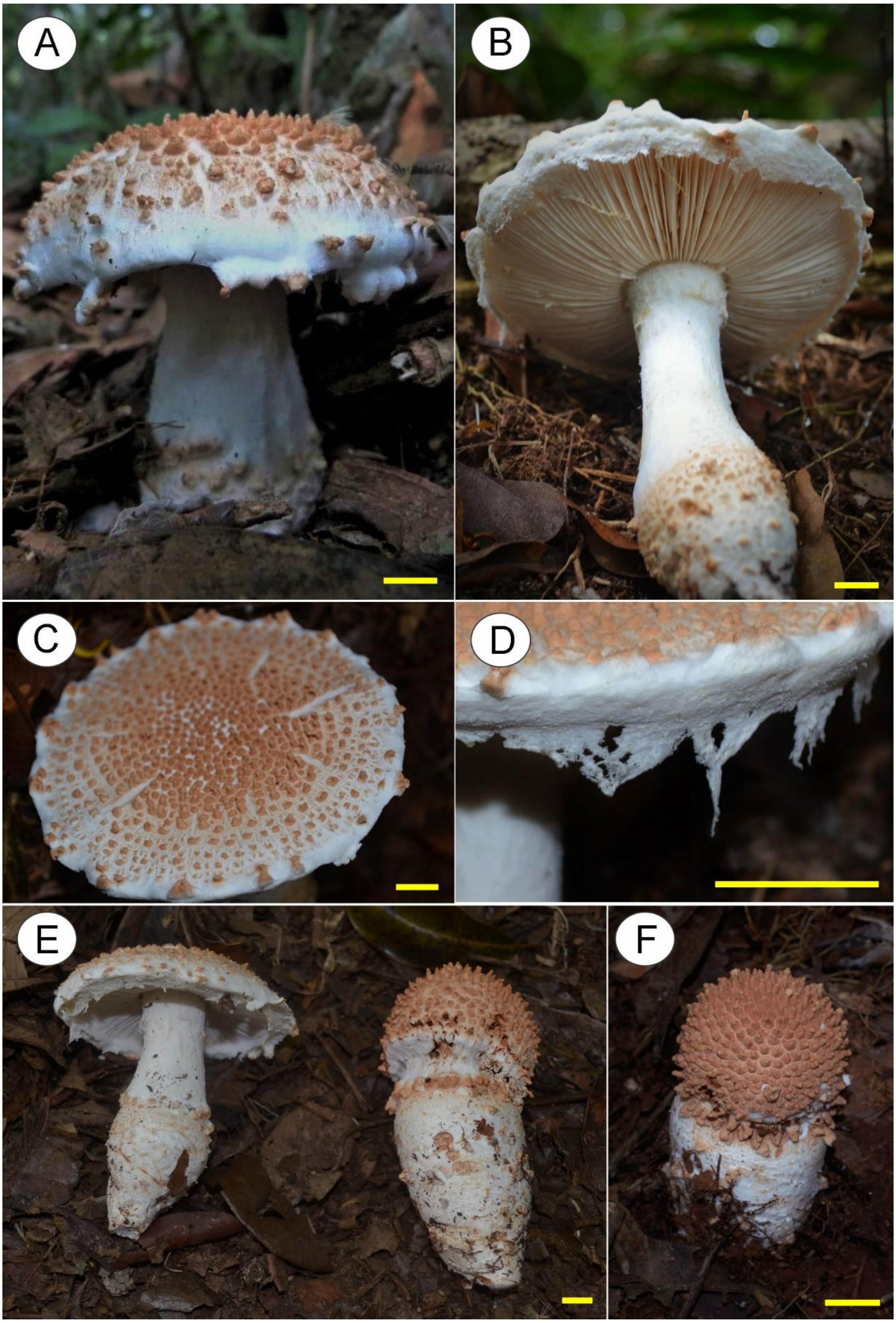

Figure 1 -- *Amanita dulceodora*: A--F, young and mature basidiomata. Scale bars = 10 mm

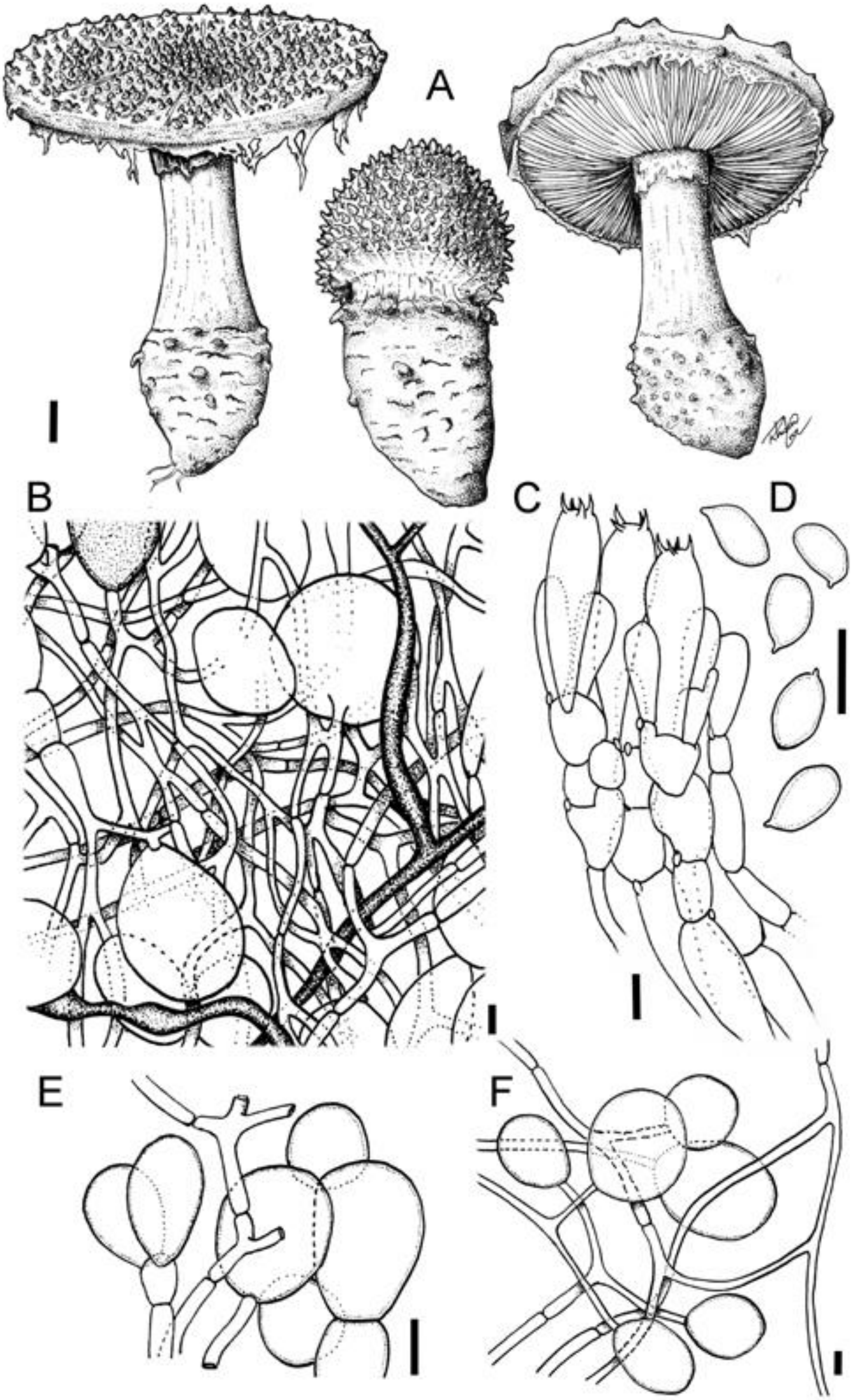

Figure 2 -- *Amanita dulceodora*: A, basidiome; B, universal veil remnants on pileus in longitudinal section; C, hymenium and subhymenium; D, basidiospores; E, lamellar edge cells; F, partial veil trama. Scale bars (A = 10 mm; B--F = 10 μm).

APÊNDICE C - ARTIGO 03

Amanita eburneopileata and *A. velutina*, two new species from Brazil with a key to Central and South America species of *Amanita* sect. *Validae*

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Abstract – *Amanita eburneopileata* and *A. velutina* are described and illustrated as a new species of *Amanita* sect. *Validae* from northeast Brazil. In addition, a dichotomous key to Central and South America species of *Amanita* sect. *Validae* is presented.

Keywords – Agaricales, Amanitaceae, morphology, new taxa, taxonomy

INTRODUCTION

Amanita Pers. encompasses more than 500 species distributed worldwide, including most of the well-known mushroom-forming species of basidiomycetes (Bas 2000, Tulloss 2005, Yang 2005). The genus is concisely characterized by the schizohymenial ontogeny of the basidiome and related character states such as sterile edges of lamellae and absence of gluten and gluten-retaining hyphae on pileus (Tulloss et al. 2016).

The genus is divided into two subgenera *Amanita* and *Lepidella* (E.-J Gilbert) Veselý, based on both morphological and molecular evidence (Bas 1969, Yang 1997, Weiß et al. 1998, Moncalvo et al. 2000). Members of subgenus *Lepidella* section *Validae* (Fr.) Quél. are recognized by their amyloid basidiospores, non-appendiculate pileus margin, non-membranous universal veil and a bulbous stipe base (Corner & Bas 1962, Bas, 1969; Yang, 1997; Tulloss & Yang, 2017). To date, the literature indicate *Amanita* section *Validae* contains ca. 75 accepted species worldwide (Tulloss & Yang, 2017). Of these, only seven occur in Central and South America: *A. brunneolocularis* Tulloss, Ovrebo & Halling, *A. campinaranae* Bas, *A. cyanopus* C.M. Simmons, T.W. Henkel & Bas, *A. flavoconia var. inquinate* Tulloss, Ovrebo & Halling, *A. perphaea* Simmons, T.W. Henkel & Bas, *A. picea* Tulloss, Ovrebo & Halling and *A. solaniolens* H.L. Stewart & Grund (Bas 1978, Tulloss et al. 1992, Simmons et al. 2002).

The continuing studies in *Amanita* Pers. in Northeast Brazil indicate several undescribed taxa are present in this region. In this paper, two new species assignable to *Amanita* sect. *Validae* are described. In addition, a dichotomous key to Central and South America species of the section is presented, including all the previously mentioned taxa.

MATERIAL AND METHODS

Material and collection localities

The studied material was collected in two Atlantic forest conservation areas from Northeast Brazil:

1) ‘Parque Estadual das Dunas do Natal’ (05º 48´ to 05º 53´ S and 35º 09´ to 35º 12´ W) --- is located in the city of Natal, Rio Grande do Norte state. The park has approximately 1,172 ha. The climate is described as tropical humid, with mean annual temperatures close to 25º C. Average annual precipitation ranges from 800 mm to 1,500 mm, with a rainy period from March to July. The vegetation has species representative from the Atlantic Forest, as well as species of the Caatinga and the Coastal Tableland forest types. The topsoil is sandy, composed mainly of marine quartz sand, dystrophic, low in fertility, and the landscape is plain with small slopes (Freire 1990).

2) ‘Reserva Biológica Guaribas’ --- a protected area located in the municipalities of Rio Tinto and Mamanguape, north coast of Paraiba state. This reserve is composed of

three forest fragments totalizing approximately 4028.55 hectares. The climate is hot and humid with an average temperature between 24 and 26°C. Average rainfall of 1700 mm / year and the rainy season ranges from February to July (Endres et al. 2007). On the reserve, prevail two physiognomies, the “Tabuleiro Nordestino” and forest areas. “Tabuleiro Nordestino” is an open formation dominated by grasses, with small-sized trees distributed sparsely, while the forests areas present higher tree density and taller trees forming closed canopy (Endres et al. 2007).

Morphological studies

Macromorphological descriptions were based on field notes and color photographs of basidiomata taken in the field. Colours of fresh and dry basidiomes were compared with reference colours in Kornerup & Wanscher (1978). Observations and measurements reported for micromorphological features were obtained from dried material rehydrated and mounted in distilled water, 3% KOH and Congo red or Melzer's reagent. Regarding biometric values and notation, we follow the emended methodology of Tulloss et al. (1992) and Tulloss (1993, 1994, 2000), which is summarized below.

At the beginning of a set of spore data, the abbreviation [*a/b/c*] signifies "*a*" basidiospores measured from "*b*" basidiomata of "*c*" collections. Dimensions of basidiospores are presented in the following form *(m--) n--o (--p),* in which "*m*" is the smallest value observed or calculated and "*p*" is the largest value observed or calculated. In the range of values observed or calculated, the 5th percentile is "*n*"; and the 95th percentile is "*o*". A summary of definitions of biometric variables follows:

L, (**W**) = the range of average lengths (widths) of spores of each basidioma examined.

L’, (**W’**) = the average of all lengths (widths) of spores measured.

Q = the ratio of length to width of a spore or the range of such ratios for all spores measured.

Q = the average of Q computed for all basidiomata examined.

Q’ = the average of all Q values computed for all spores measured.

The holotype is kept at the mycological collection of JPB (Thiers, continuously updated).

ESPECIES DESCRIPTION & DISCUSSION

Amanita eburneopileata C.C. Nascimento & Wartchow, **sp. nov.**
MycoBank # 000000

Diagnosis -- Basidiome medium-sized. Pileus 40--60 mm wide, uniformly greyish yellow/ivory to greyish orange; wih universal veil remnants golden blond to clay to oak brown; entire at margin; lamellae pale cream to dirty cream, unchanging, lamellulae attenuate to attenuate in steps; basal bulb spindle-shaped, with *r*emains of universal veil forming brownish-greyish powdery to slightly warty girdles at upper part; basidiospores (5.7--)6.2--8.6(--8.7) × (4.8--)4.9--6.7(--8.1) µm, mostly broadly ellipsoid to ellipsoid, sometimes subglobose, rarely elongate, amyloid; clamp connections absent. -- Type: Brazil, Paraíba, Mamanguape, REBIO Guaribas I, 30 Jun. 2012, leg. F. Wartchow FW 109/2012 (JPB 00000). Figs 1 & 2.

Macroscopic characters -- Basidiome medium-sized, solitary. **Pileus** 40--60 mm wide, convex to plano-convex to planar in maturity; surface dry, glabrous, shiny, uniformly greyish yellow/ivory (4B3) to greyish orange (5B3), in general fading in sunlight, without surface staining or bruising; *margin* entire, nonstriate, nonappendiculate; *universal veil* as a thick and coarse crust-like covering on the disk; elsewhere as scattered, coarse, truncate-subpyramidal to low irregular warts or flat, angular patches, golden blond (5C4--5) to clay (5D5) to oak brown (5C6), becoming brownish orange (6C8) to reddish golden (6C7) on tips, darkening with age, adnate (but rather easily broken and then leaving irregular scar on remaining universal veil tissue); *context* to 3 mm thick at stipe, firm, whitish to yellowish white (1A2, 2A2), unchanging, turning gradually thinning toward margin. **Lamellae** free, subcrowded to crowded, up to 4 mm high. (at the central lamellae), pale cream (4A2--3) to dirty cream, unchanging; edge entire, smooth, concolorous; *lamellulae* attenuate to attenuate in steps, plentiful, unevenly distributed, of diverse lengths. **Stipe** 80--93 (excluding bulb) × 11--13 mm (at midstipe), cylindric or tapering upwards, flaring slightly at the top, minutely appressed-fibrillose, concolour with pileus but somewhat pale orange (5A4--5) at lower stipe and bulb; *basal bulb* spindle-shaped (up to 20 mm long and up to 18 mm wide); *context* solid, firm, whitish, unchanging; *remains of universal veil at top of bulb* friable**,** forming brownish-greyish powdery to slightly warty girdles. **Partial veil** submembranous, apical to superior, skirt-like, upper surface with fine subradial striations, persistent, off-white to buff (3A3, 4A2), drying greyish orange (5B4) to golden blonde (5C4--5) to dark blonde (5D4). **Spore print** white to cream. **Odor** indistinct. **Taste** not performed.

Microscopic characters -- **Basidiospores** [60/2/1] (5.7--)6.2--8.6(--8.7) × (4.8--)4.9--6.7(--8.1) μm [**L** = 6.9--7.5 μm; **L'** = 7,2 μm; **W** = 5.5--6.0 μm; **W'** = 5.7 μm; Q = (1.06--) 1.08--1.51(--1.64); **Q** = 1.21--1.32; **Q'** = 1.26], mostly broadly ellipsoid to ellipsoid, sometimes subglobose, rarely elongate, hyaline, amyloid, smooth, thin-walled, usually with a large guttule; apiculus ca. 1 μm long, cylindric. **Basidia** (33--) 37--55 (60--) × 8--14 (--16) μm, clavate, thin-walled, dominantly 4-spored, occasionally 2-spored, with sterigmata to 9 × 3 μm; no clamps observed. **Subhymenium** cellular, 25--38 thick, with 2--4 layers of globose to subglobose to pyriform elements (8--20 × 7--18 μm), but sometimes also including short un- or partially inflated hyphal segments, with basidia arising singly or in small group from inflated and occasionally from short partially inflated hyphal segments. **Lamellar trama** bilateral, divergent, all elements thin-walled; mediostratum 30--55 μm wide, composed of filamentous hyphae 3.5--7 μm wide, with fairly abundant intercalary cells (ellipsoid to fusiform to narrowly fusiform, 23--38 × 8--14 μm); lateral stratum made up of abundant ellipsoid (40 × 16 μm) to ovoid to clavate cells (35 × 20 μm), mixed with branching filamentous hyphae 2.5--9 μm wide; terminal, inflated cells not observed; vascular hyphae and clamp connections not observed. **Lamellar edge tissue** sterile, composed of clavate to broadly clavate to sphaeropedunculate, thin-walled, colorless or pale yellow cells [(22--)27--43 × 10--22 μm], single and terminal, occasionally in chains of 2--3; filamentous hyphae fairly abundant, 2.5--6 μm wide, thin-walled, hyaline. **Pileipellis** 120--200 μm thick, 1-layered, merely or somewhat denser, entirely ungelatinized; filamentous hyphae 3.5--10(--12) μm wide, with some segments projecting upward and binding intimately the upper surface to remains of universal veil, thin-walled, hyaline or with intracellular yellowish pigment, occasional hyphal tips slightly swollen; vascular hyphae not observed. **Universal veil on pileus** with elements having subvertical to vertical orientation, but taking on a periclinal orientation near the pileipellis; filamentous hyphae 3.0--11 μm wide, thin-walled, branching, hyaline, sometimes with brownish vacuolar pigments, occasionally colorless, plentiful to dominant at base, plentiful above basal region, uninflated hyphal end segments noted; inflated cells colorless to pale olive brown to pale brownish gray, plentiful, terminal, singly or in chains of two, with walls thin to slightly thickened (up to 0.5 μm thick), globose to subglobose to ovoid (30--85 × 28--75 μm), or broadly ellipsoid to broadly clavate (40--70 × 25--35 μm), occasionally fusiform-ellipsoid to fusiform-rostrate; vascular hyphae 4.0--12 μm wide, sinuous, infrequent, not branching. **Universal veil on upper part of bulb** composed of inflated cells in easily dissociated chains, dominant, subglobose (20--47 × 17--45 µm) to ellipsoid (30--80 × 12--45 µm) or clavate (40–65 × 12–26 µm), with walls thin to slightly thickened (up to 0.5 µm thick); vascular hyphae not observed. **Stipe context** of branching filamentous hyphae 2.5--14 µm wide, thin-walled; acrophysalides to 170 × 24 µm, subfusiform to narrowly clavate to elongate-ellipsoid, dominating, colourless; vascular hyphae 2.5--6 µm wide, branching, infrequent. **Partial veil** dominantly consisting of subradially arranged, filamentous hyphae 2--9 (--11) µm wide, branching, sometimes anastomosing; inflated cells plentiful, narrowly clavate, occasionally slightly constricted, terminal, singly, yellowish; vascular hyphae not observed; clampless.

Other collections examined -- Brazil: Bahia, Chapada da Diamantina, Abaíra, Catolés de Cima, Serra do Barbado, Mata do Tijuquinho 9 Jan. 2015, *F. Wartchow* et al. FW 07/2015 (JPB 00000).

Habit and Habitat -- solitary on sandy soil in Dense Ombrophilous Forest (Atlantic rainforest biome).

Etymology – from Lat., ‘ebur’ (= ivory), ‘-pilleus’ (= cap) and ‘-atus’ (= used to form adjectives from nouns indicating the possession of a thing or a quality.

Known distribution -- Only known from the type locality, in the ‘REBIO Guaribas I’, Mamanguape, Brazil.

Notes -- *Amanita eburneopileata* is assignable to *Amanita* sect. *Validae*, which is characterized by amyloid basidiospores, non-appendiculate pileus and non-membranous universal veil (Corner & Bas 1962, Bas 1969). It is well circumscribed by its (1) ivory to greyish orange colored pileus covered with truncate-subpyramidal to low irregular warts or flat, angular patches; (2) pale cream to dirty cream lamellae; (3) a minutely appressed-fibrillose stipe with turnip-shaped basal bulb; (4) a persistent partial veil, (5) mostly subglobose to ellipsoid amyloid basidiospores and (6) absence of clamps.

Among the species in sect. *Validae*, the neotropical *A. brunneolocularis* Tulloss, Ovrebo & Halling., originally described from Andean Colombia, exhibits closest similarity to the new species. It resembles *A. eburneopileata* in its convex to plano-convex pileus with universal veil mostly as brownish patch-like remnants; stipe surface with a fine coating of appressed fibrils; and absence of clamps at the bases of basidia. However, *A. brunneolocularis* differs from *A. eburneopileata* in having pileus color ranging from dull drab tan-buff to sordid flesh-color to somewhat reddish brown; pure white to whitish buff lamellae with a fimbriate edge and broader basidiospores, [(6.5--)7.5--10.0(--12.5) × (5.0--)5.8--7.8(--9.0)] (Tulloss et al. 1992) or (6.5--

)7.5--10.0(-12.5) × (5.0--)5.8--7.8(--9.0) µm (Tulloss & Yang 2017). Furthermore, the basidiome displays a red staining reaction when cut or bruised (Tulloss et al. 1992).

Amanita campinaranae Bas is other somewhat morphologically close species from sect. *Validae* that could be compared with *A. eburneopileata*. It occurs in *Campinarana* type vegetation under leguminous trees and trees of the family *Sapotaceae* in the Brazilian state of Amazonas. Both species share universal veil on pileus as crust- to patch-like remnants and on stipe base as powder to slightly warty girdles. However, *A. campinaranae* is distinguishable from *A. eburneopileata* by its glabrous stipe with submarginate to marginate bulb and distinctly smaller basidiospores (5.6--6.7 × 5.5--6.5 µm; Q = 1.0--1.15; **Q** = 1.05; **Q'**= 1.05) (Bas 1978).

Amanita velutina C.C. Nascimento & Wartchow, **sp. nov.**

MycoBank # 000000

Diagnosis – Basidiome medium size. Pileus 50--70 mm wide, lead gray (2D2) to olive grey (2E2); universal veil as velutinous, sepia (4F4, 5F4) to smoke brown (4F2) patches; lamellae pure white to whitish buff, unchanging, lamellulae attenuate to nearly truncate; basal bulb turnip-like to somewhat like a short carrot, with *r*emains of universal veil forming fragile, small, detersile, pallid grayish patches on the lower stem or upper part of the bulb; basidiospores 5.5--)6.5--8.5(--9.0) × (4.0--)4.8--6.5(--7.5) µm, broadly ellipsoid to ellipsoid, rarely subglobose, amyloid; clamp connections absent. -- Type: Brazil, Rio Grande do Norte, Natal, Parque Estadual das Dunas do Natal (PEDN) – Trilha da Geologia, 18 May. 2011, leg. M. Sulzbacher MS0349 (JPB 00000). Figs 1 & 3.

Macroscopic characters — Basidiome medium size. **Pileus** 50--70 mm wide, broadly convex to campanulate; surface dry, dull to subpolished, lead gray (2D2) to olive grey (2E2), darkest at disk with color at times appearing to be in inherent radial fibrils, not discoloring; **margin** entire, nonstriate, sometimes appendiculate with large pieces of the ring, incurved to decurved; **universal veil on pileus** as velutinous, detersile, sepia (4F4, 5F4) to smoke brown (4F2) patches with pallid undersides and margins, darkening with age, becoming smaller and more scattered toward margin. **context** white (1A1) to pale yellow (2A2), up to 2--4 mm thick at stipe, unchanging. **Lamellae** free to slightly adnexed, crowded, pure white to whitish buff, unchanging, up to 4 mm high, thin to moderately thick, occasionally forked; edge entire, smooth, concolorous; lamellulae attenuate to nearly truncate, plentiful, unevenly distributed, in 2--3 ranks. **Stipe** 89--95 × 9--15 mm (at midstipe) nearly cylindrical, usually slightly thickening towards the base, fistulose, smooth and white (1A1) above partial veil, elsewhere yellowish white (4A2) to pale yellow (4A3) on background, covered with greyish yellow (champagne, 4B4) reflexed squamules, bruising light tan where handled; **basal bulb** 20--25 × 15--19 mm, turnip-like to somewhat like a short carrot; **context** white (1A1) to pale yellow (2A2), unchanging; **remains of universal veil** as fragile, small, detersile, pallid grayish patches on the lower stem or upper part of the bulb, not persisting in dry material; **partial veil** is superior, membranous, thin, skirt-like, persistent, striate on upper surface, smooth below, white (1A1) to off-white, champagne (4B4) to amber yellow (4B6) at edge. **Spore print** white. **Odor** mild, indistinct, or fungoid. **Taste** not performed.

Microscopic characters -- **Basidiospores** [60/3/2] (5.5--)6.5--8.5(--9.0) × (4.0--)4.8--6.5(--7.5) μm [**L** = 7.5--8.0 μm; **L'** = 7,7 μm; **W** = 5.4--6.0 μm; **W'** = 5.7 μm; Q = (1.11--) 1.15--1.38(--1.50); **Q** = 1.25--1.32; **Q'** = 1.29], broadly ellipsoid to ellipsoid, rarely subglobose, hyaline, amyloid, thin-walled, smooth; contents guttulate; apiculus small, mostly truncate subconic. **Basidia** 35--47 × 15--18.5 (--20.5) μm, clavate to broadly clavate, thin-walled, dominantly 2-spored, with sterigmata short and slender; no clamps observed. **Subhymenium** 25--45 μm thick, with 2--3 layers of subglobose, broadly clavate, ovoid to short ellipsoid cells, [10--25(--30) × 8--16.5(--20) μm]. **Lamellar trama** bilateral, with a shallow angle of divergence, mostly elements thin-walled, but sometimes walls slightly thickened, to 0.5 μm thick; mediostratum narrow, dominated by filamentous, undifferentiated hyphae 2.0--7 μm wide, with some segments inflated to 16 μm wide, branching, interwoven; lateral stratum composed of abundant clavate to fusiform to elongate cells (to 70 × 20 μm), mixed with few filamentous hyphae 3.5--8 μm wide, branching; vascular hyphae common, 2.3--8 μm wide, sparsely branching, pale brown; clamp connections not observed. **Lamellar edge tissue** sterile dominated by inflated cells, globose to subglobose or broadly clavate [14--25 × 11--20(--23) μm], mostly showing brownish to brown vacuolar pigments; filamentous hyphae 3--7 μm wide, hyaline, colorless, thin-walled, fairly abundant to scattered; **Pileipellis** 50--90 μm thick, 1-layered, gelatinized at surface; filamentous, undifferentiated hyphae 1.5--9 μm wide, branching, subradially and compactly arranged, many with pale brown to pale grayish brown intracellular pigment; vascular hyphae 2.0--12 μm wide, not branching, relatively common. **Universal veil on pileus** composed of irregularly arranged elements, gelatinized at interface with pilleipelis; inflated cells dominant, globose to subglobose to ovoid [10--40(--55) × 9--38(--48) μm], occasionally fusoid (to 60 × 25 μm), terminal, single or in short chains, mostly with pale brown to pale orange-brown intracellular pigment, with walls 0.5--1.0 μm thick, sometimes thin-walled; branched, filamentous hyphae fairly abundant near the interface with pileipellis, sparse elsewhere, 1.5--11 μm wide; vascular hyphae rare. **Universal veil Absent from stipe base**.

Stipe context longitudinally acrophysalidic; filamentous hyphae fairly abundant, 2--5 µm wide, branching, thin-walled; acrophysalides dominant, to 220 × 40 µm, elongate-clavate; vascular hyphae infrequent, 8--10 µm wide, not branching. **Partial veil** branching filamentous hyphae dominant, 1.5--6 µm wide, mostly radially arranged, sometimes in fascicles; inflated cells scattered, clavate to broadly clavate, to 102 × 30 µm, thin-walled, colorless, terminal, singly; vascular hyphae 4--11 µm wide, relatively common, sinuous, not branching.

Other collections examined -- Brazil: Rio Grande do Norte, Natal, Parque Estadual das Dunas do Natal, 23 Jun. 2007, *E.P. Fazolino & B.D. Silva* s.n et al. FW 134/2012 (URM).

Habit and Habitat -- solitary to subgregarious on sandy soil of native tropical forest on coastal dune (Atlantic rainforest biome).

Etymology -- from Lat., 'velutinus' (= velutinous). Referring to the velutinous texture of the universal veil.

Known distribution -- Only known from the type locality, in the 'Parque Estadual das Dunas do Natal -- Trilha da Geologia', Natal, Brazil.

Notes -- *Amanita velutina* is a member of *Amanita* sect. *Validae*. Morphologically, *A. velutina* shows some morphological similarities with *A. brunneolocularis*, *A. campinaranae*, *A. eburneopileata* (this paper).

KEY TO CENTRAL AND SOUTH AMERICAN SPECIES OF *AMANITA* SECTION *VALIDAE*

1a. Basidiomata bruising reddish brown in all parts……...………….….….***A. brunneolocularis***
1b. Basidiomata not bruising reddish brown in any part……………………………….…………..**2**
  2a. Stipe base bearing a soft, abrupt, marginate bulb ………………...……***A. solaniolens***
  2b. Stipe base lacking an abrupt or marginate bulb………………………..……………**3**
    3a. Pileus orange-yellow to yellow-orange to brownish orange; universal veil yellowish, often lacking on pileus…...……...………***A. flavoconia var. inquinata***
    3b. Pileus whitish, dark brown, gray, pale grayish, greyish yellow (ivory), olive gray or bluish turquoise; universal veil gray to brownish gray to brownish, rarely lacking on pileus **4**
      4a. Spores globose to subglobose, rarely broadly ellipsoid, with **Q** < 1.10.........…**5**

5a. Pileus white to pallid grayish, with a nonstriate margin; universal veil present as subfelted, crust-like remnants over the center and more isolated patches elsewhere…...…………………………***A. campinaranae***

5b. Pileus gray, darkening towards center, with a sulcate-striate margin; universal veil as conical warts, more concentrated at the central region……………………………………………………...…***A. perphaea***

4b. Spores broadly ellipsoid to ellipsoid, infrequently subglobose or elongate, with **Q** > 1.20………….......................………...…………………….…………**6**

6a. Basidiomata with blue pigment..***A. cyanopus***

6b. Blue pigment absent..**7**

7a. Pileus brownish black. Basal bulb splitting longitudinally, with universal veil forming concentric rings of coarse pyramidal to subpyramidal warts……...……………..……………….……….***A. picea***

7b. Pileus never dark colored. Bulb turnip-shaped, with inconspicuous universal veil remnants…………………….................................**8**

8a. Universal veil on pileus adnate as a crust-like covering on the disk; elsewhere as scattered, truncate-subpyramidal to low irregular warts or flat, angular patches. Stipe surface minutely appressed-fibrillose……………………...………………....***A. eburneopileata***

8b. Universal veil on pileus detersile as scattered, velutinous patches. Stipe surface covered reflexed squamules…………......…***A. velutina***

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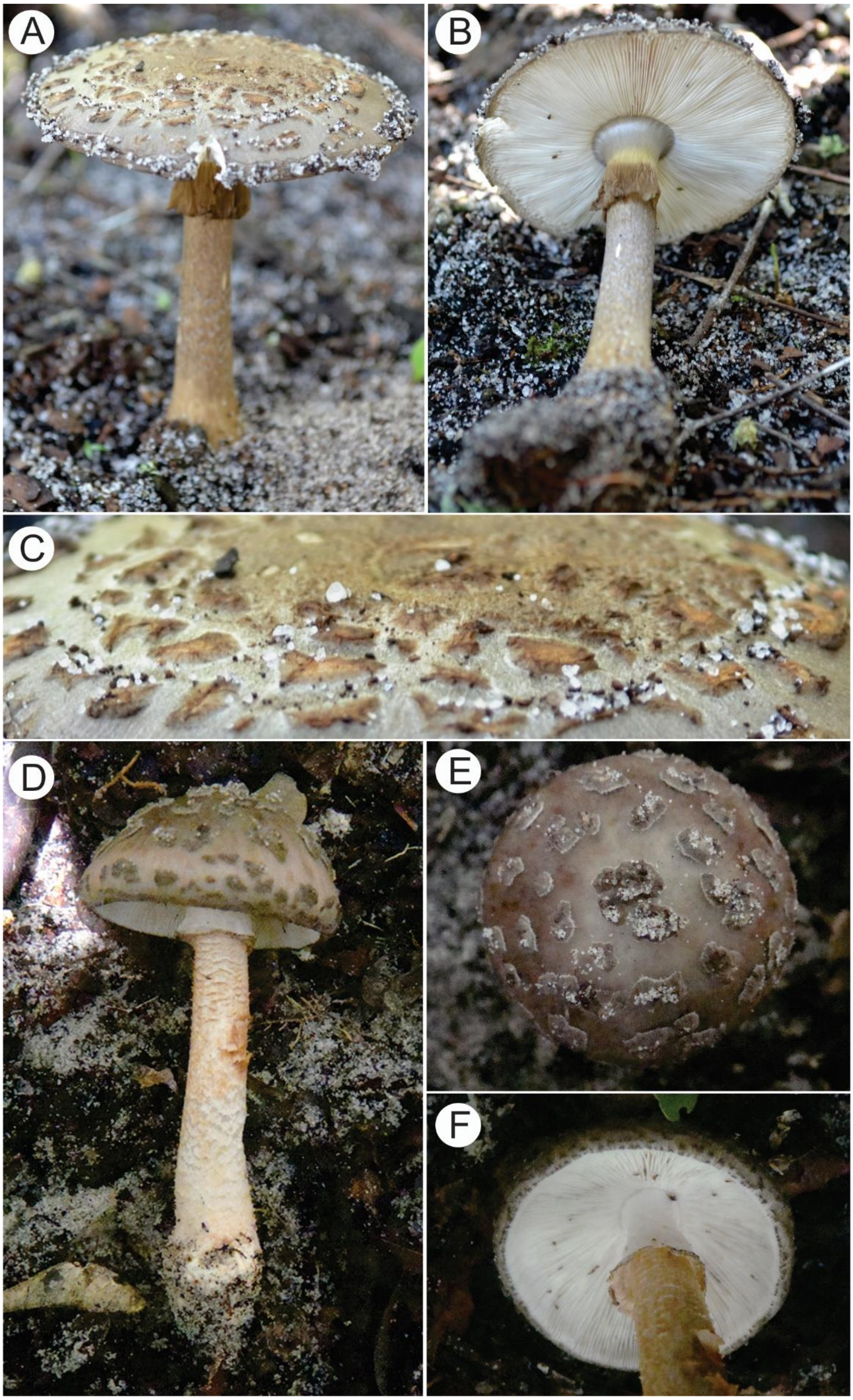
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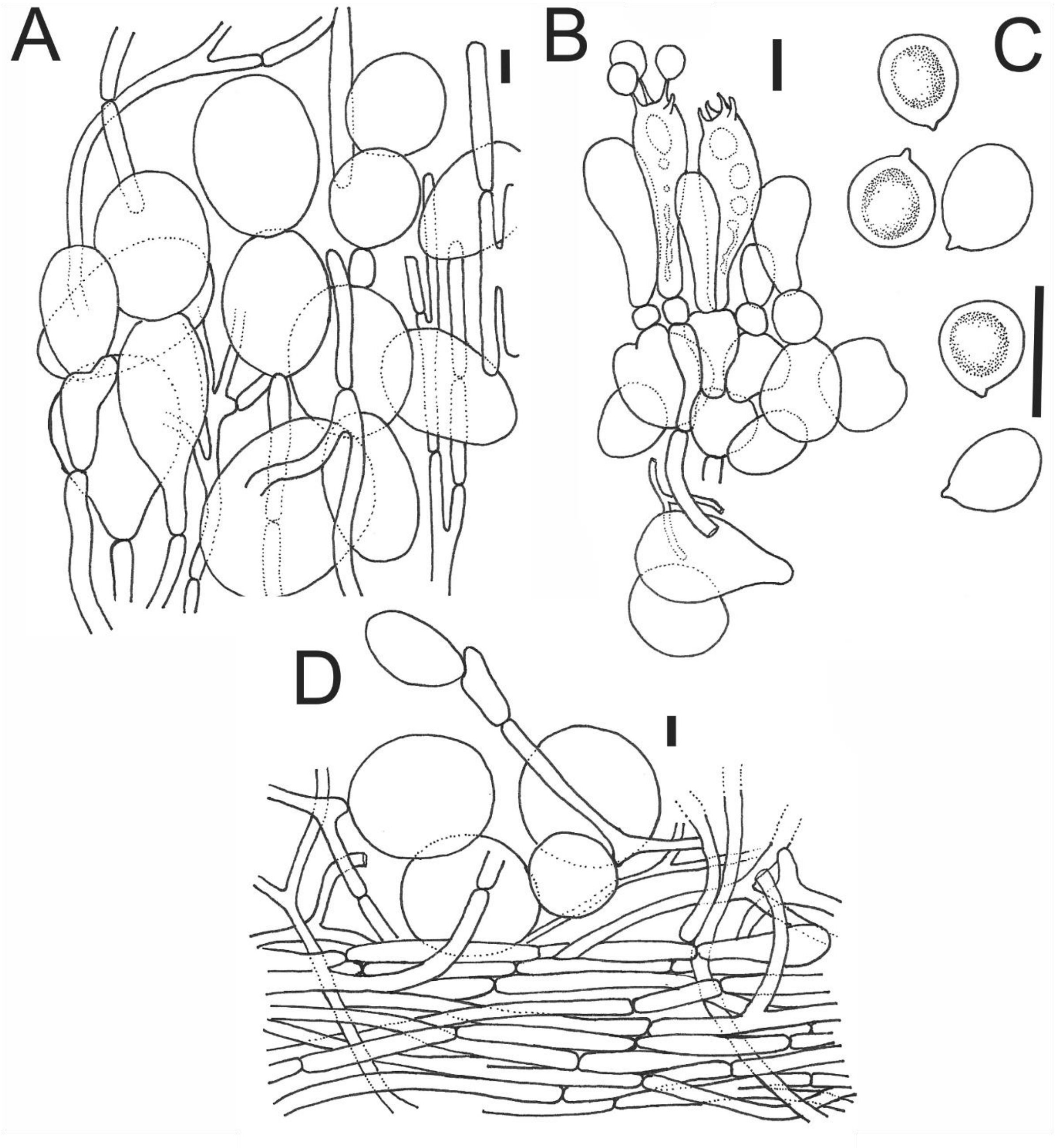
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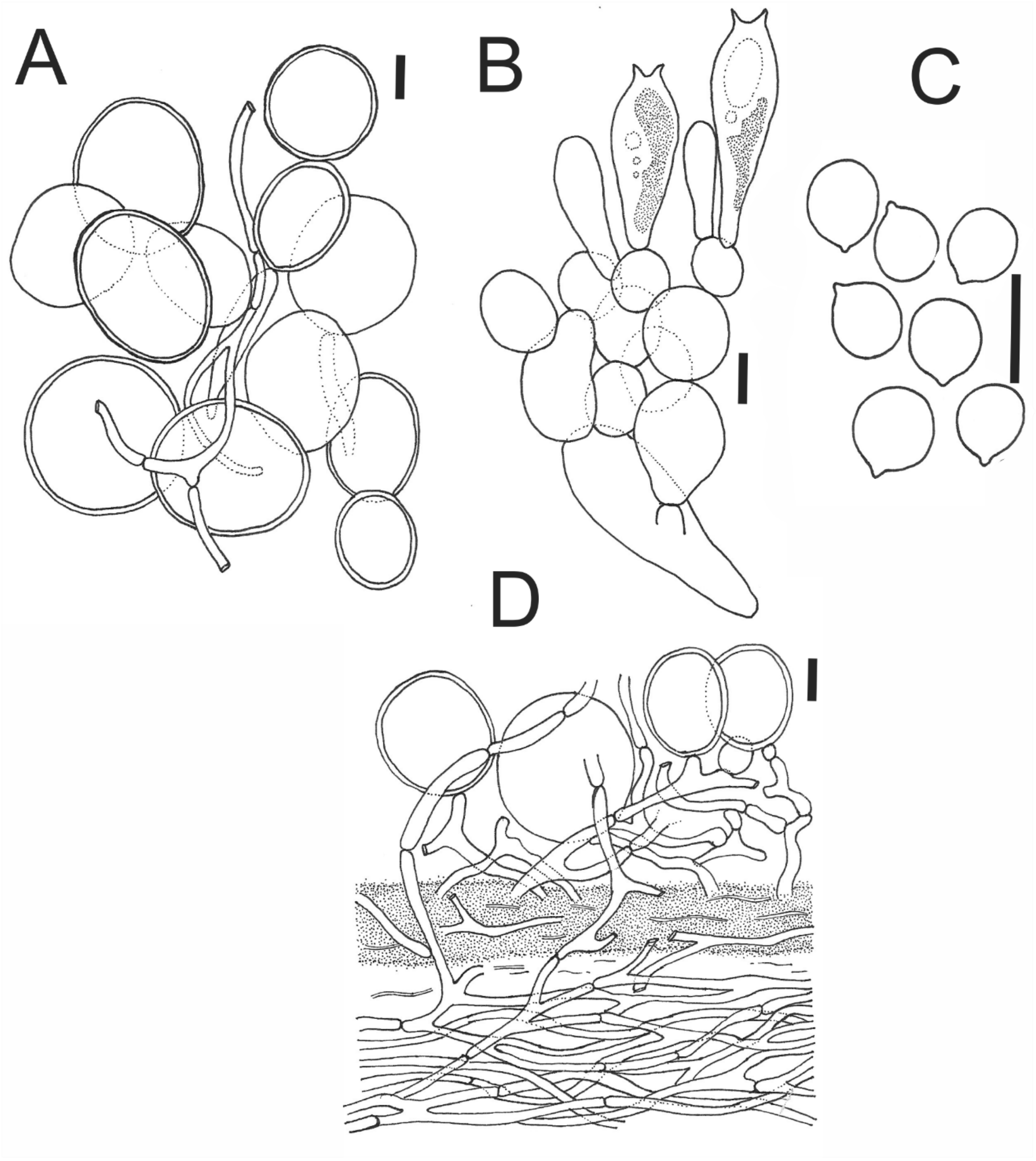
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Figure 1-- Basidiomata of two new *Amanita* sect. *Validae* from northeast Brazil: A--C, *A. eburneopileata* (FW 109/2012); D--F, *A. velutina* (MS0349).

Figure 2 -- *Amanita eburneopileata*: A, universal veil remnants on pileus in longitudinal section; B, hymenium and subhymenium; C, basidiospores; D, elements of the universal veil on pileus and the adjacent pileipellis. Scale bars = 10 μm.

Figure 3 -- *Amanita velutina*: A, universal veil remnants on pileus in longitudinal section; B, hymenium and subhymenium; C, basidiospores; D, elements of the universal veil on pileus and the adjacent pileipellis. Scale bars = 10 μm.

APÊNDICE D - ARTIGO 04

Three new species of *Amanita* sect. *Validae* from Brazilian Northeast

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Abstract -- Mushrooms belonging to the genus *Amanita* were collected during a fungal biodiversity study in northeast Brazil in 2014--2017. Morphological characteristics analyses were used to identify the specimens. Three species assignable to *Amanita* section *Velidae* are described as new and compared with phenetically similar species.

Keywords – Agaricales, Amanitaceae, morphology, neotropics, taxonomy

INTRODUCTION

Recent collecting and study in Atlantic forest remnants from Northeast Brazil led to the recognition of three undescribed *Amanita* species. Here, these are described and illustrated as new species in sect. *Validae*. The paper of Nascimento & Wartchow (unpubl. data) can be considered a previous work in the present series. Previous work on *Amanita* from Northeast Brazil includes Wartchow & Maia (2007), Wartchow et al. (2007, 2009, 2013, 2015), Menolli et al. (2009) and Wartchow (2016). A checklist and brief descriptions of Brazilian species of *Amanita* can be found in Nascimento et al. (unpubl. data).

MATERIAL AND METHODS

The usual methodology on studies in agaric fungi was followed (Singer 1986) and colours were named based on Kornerup & Wanscher (1978). Microscopic examinations were on a Coleman microscope from dried material rehydrated and mounted in 3% KOH and Congo Red solutions. For the biometric values, the emended methodology of Tulloss & Lindgren (2005), slightly modified by Wartchow & Gamboa-Trujillo (2012), was performed as follows: **L** (**W**) = the range of average lengths (widths) of spores of each basidioma examined; **L'** (**W'**) = the average of all lengths (widths) of spores measured of all basidiomata; Q = the ratio of length to width of a spore or the range of such ratios for all spores measured; **Q** = the average value of Q computed for one specimen examined and the range of such averages; **Q'** = average value of Q computed for all spores measured of all basidiomata; specific terms used for *Amanita* are summarized by Nascimento & Wartchow (*unpubl. data*). Generic and infrageneric names and concepts follow Corner & Bas (1962) and Bas (1969), as modified by Yang (1997). The holotype is deposited at JPB (Thiers, continuously updated).

TAXONOMY

Amanita aureonitida C.C. Nascimento & Wartchow, **sp. nov.**
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Diagnosis – Basidiome small to medium-sized. Pileus 40–60 mm wide, surface subpolished, golden blonde to golden to golden brown, with pigment distribution suggesting fine radial fibrils, with universal veil in detersile**,** felty patches or small warts; lamellae white to whitish, unchanging; lamellulae plentiful, truncate; basal bulb ventricose to ovoid, to 20 mm wide, with universal veil as sparse fragments around upper part of bulb or on the lower stem; basidiospores (6.1--)6.6--8.2(--9.2) × (5.4--)5.6--7.3(--8.1) µm, subglobose to broadly ellipsoid, occasionally globose, rarely ellipsoid, amyloid, clamp connections absent. -- Type**:** Brazil, Paraíba, Mamanguape, REBIO Guaribas I, 13 Jul. 2017, leg. C.C. Nascimento CN068 (JPB 00000).

Macroscopic characters -- Basidiome small to medium-sized, solitary. ***Pileus*** 40--60 mm wide, subglobose when young, convex at maturity; surface dry, glabrous, subpolished, golden blonde (5C3--4) when young, golden (4C6) to golden brown (5D7) at maturity, with pigment distribution suggesting fine radial fibrils, darkening in the center with age; margin nonstriate, nonappendiculate, decurved at first, becoming rimose; universal veil as detersile**,**

felty patches or small warts, initially greyish yellow (4B3) to grayish beige (4C2), becoming brownish to dark brownish (6F5--6) in age; context to 4 mm thick above stem, soft, whitish to yellowish white (1A2, 2A2), unchanging. ***Lamellae*** free, crowded, up to 3 mm high, white (1A1) to whitish, unchanging; edge entire, smooth, concolorous; lamellulae plentiful, several ranks, truncate. ***Stipe*** 60--95 × 9--12 mm, subcylindric or slightly attenuate upward, with apex slightly expanded; surface dry, glabrous, greyish white (1B1) above partial veil, elsewhere pale greyish orange (5B4), with outer layer breaking into reflexed squamules with age; basal bulb ventricose to ovoid, to 20 mm wide; context white in the upper stipe, with orange pigment in the base, solid or becoming hollow in lower portion; universal veil as sparse fragments around upper part of bulb or on the lower stem, easily lost during the collection process. ***Partial veil*** superior, persistent, submembranous, rather thin, skirt-like, finely striate above, smooth below, greyish orange (5B4) to brownish orange (5C4); edge slightly thickened, whitish. **Spore print** white. ***Odor*** fungoid. ***Taste*** not performed.

Microscopic characters — ***Basidiospores*** [90/3/1] (6.1--)6.6--8.2(--9.2) × (5.4--)5.6--7.3(--8.1) µm [**L** = 7.3--7.7 µm; **L'** = 7.5 µm; **W** = 6.2--6.6 µm; **W'** = 6.4 µm; Q = (1.00--) 1.08--1.29(--1.39); **Q** = 1.15--1.19; **Q'** = 1.17], subglobose to broadly ellipsoid, occasionally globose, rarely ellipsoid, amyloid, hyaline, smooth, thin-walled, contents guttulate or occasionally granular; apiculus sublateral, cylindric, occasionally rather broad. ***Basidia*** (20--)25--40(50--) × 7--9(--12.5) µm, narrowly clavate to clavate, thin-walled, 4- or occasionally 3- or 2-sterigmate, with sterigmata to 5 × 2 µm or larger; clamps absent. ***Subhymenium*** cellular**,** 30--45 µm thick, with 2--4 layers of subglobose, ovoid, oblong, clavate to irregularly shaped cells, 12--30 × 8--27 µm. ***Lamellar trama*** bilateral, divergent; mediostratum 40--60 µm thick, composed largely of branching filamentous hyphae 2--10 µm wide, with frequent intercalary fusiform to broadly fusiform to clavate inflated segments, to 50 × 16 µm; subhymenial base dominated by diverging inflated to partially inflated hyphal segments, narrowly clavate to narrowly ventricose, to 110 × 30 µm; vascular hyphae 3--7 µm wide, infrequently branching, sinuous, uncommon; clamps absent. ***Marginal tissue of lamellae*** sterile, inflated cells dominating, subglobose to broadly clavate cells, 18--29 × 14--18 µm, single or in pairs, colorless and hyaline, thin-walled. ***Pileipellis*** 100--160 µm thick, 2-layered; subpellis yellowish brown to dark yellowish brown, non-gelatinized, 60--90 µm thick; suprapellis colorless, extensively gelatinized, 40--70 µm thick; filamentous hyphae 2--9(--11) µm wide, branched, interwoven, subradially arranged, thin-walled, hyaline or with intracellular yellowish pigment; vascular hyphae 3--7 µm wide, common at upper layer, sinuous, infrequently branching, without dominant orientation. ***Universal veil on pileus*** composed of subradially to somewhat irregularly arranged elements; filamentous hyphae 3--9 µm wide, fairly abundant, branching, hyaline, mostly thin-walled, but sometimes walls slightly thickened in hyphae of larger diameter; inflated cells dominant, subglobose (25--117 × 22--106 µm) or ovoid to ellipsoid (32--80 × 26--65 µm) or clavate to narrowly clavate (32--53 × 15--27 µm), terminal single or in chains of (2--)3--4, thin-walled or with walls 0.5--0.8 µm thick, hyaline or with pale greyish brown intracellular pigment; vascular hyphae rare or locally conspicuous, 2--10 µm wide, sinuous. ***Universal veil Absent from stipe base***. ***Stipe trama*** longitudinally acrophysalidic; filamentous hyphae scattered to fairly abundant, 2.5--12 µm wide, branching, thin-walled, hyaline; acrophysalides dominant, to 230 × 28 µm, narrowly clavate, colourless; vascular hyphae rare, 3.5--6 µm wide; clamp connections not observed. ***Partial veil*** filamentous hyphae 2--7.5 µm wide, branched, with a majority subradially oriented; inflated cells terminal or in short chains, clavate to subclavate to subcylindrical to 40 × 20 µm; vascular hyphae not observed.

Habit and Habitat -- solitary on sandy soil in Dense Ombrophilous Forest (Atlantic rainforest biome).

Etymology -- from Lat., ‘aureo’ (= gold-colored;) and ‘-nitida’ (= shining, polished).

Known distribution -- Only known from the type locality, in the ‘REBIO Guaribas I’, Mamanguape, Paraíba state, Brazil.

Remarks -- *Amanita aureonitida* is characterized by its (1) small to medium-sized basidiome, (2) golden to golden brown pileus surface with a darker centre with age, (3) greyish to brownish universal veil remnants in the form of felty patches or small warts, (4) greyish orange to brownish orange skirt-like partial veil that is whitish at the thicker free edge, (5) ventricose to ovoid basal bulb, and (6) small basidiospores (subglobose to broadly ellipsoid, occasionally globose, rarely ellipsoid, **Q’** = 1.17). This species belongs with those of sect. *Validae* distinguished by the small basidiospores that occur in tropical forests in Brazil and Guyana, such as *A. campinaranae* Bas, *A. cyanopus* Simmons et al., *A. griseosplendida* (this paper) and *A. perphaea* Simmons et al. However, can be easily distinguished from each of those taxa because of their (2), (4) and (5) above mentioned features.

Amanita griseosplendida C.C. Nascimento & Wartchow, **sp. nov.** (Bars = 20 mm)
MycoBank # 000000,

Diagnosis – Basidiome large-sized. Pileus 80--120 mm wide, surface subpolished, virgate, platinum to olive grey to neutral grey, with universal veil as concentric arranged, subfelted to felted to submembranous patches; lamellae white to whitish, unchanging; lamellulae common, attenuate; basal bulb to 38 mm wide, subglobose, with universal veil as a very thin dark ring around the upper part of bulb; basidiospores (5.6--)5.9--6.6(--7.1) × (5.1--)5.3--5.8(--6.1) µm, globose to broadly ellipsoid, amyloid; clamp connections absent. -- Type: Brazil, Rio Grande do Norte, Natal, Parque Estadual das Dunas do Natal (PEDN), 05 Jul. 2017, leg. A.G. Santos AGS877 (JPB 00000).

Macroscopic characters — Basidiome large-sized, solitary. ***Pileus*** 80--120 mm wide, fleshy, plano-convex, applanate, or centrally depressed with reflexed margins at maturity, splitting radially; surface dry, subpolished, virgate, platinum (1D1) to olive grey (1D2) to neutral grey (1E1); margin nonstriate, nonappendiculate; universal veil as concentric arranged, apressed, subfelted to felted to submembranous patches, greyish yellow (4B3--4) near margin, becoming brownish orange (5C3--4) to light brown (5D5) towards centre; context to 8 mm thick above stem, thinning evenly to margin, white (1A1) to off-white, yellowish under pileipellis, unchanging. ***Lamellae*** free, crowded, up to 6 mm high, rather thick, white (1A1) to whitish, unchanging; edge entire to irregular, smooth, concolorous; lamellulae common, attenuate, in 2--3 ranks, unevenly distributed. ***Stipe*** 75--90 × 20--25 mm, cylindric or narrowing upward, barely flaring at apex; surface dry, glabrous, with fine longitudinal striations, greyish brown (5D3) to light brown (5D4); basal bulb subglobose and significantly broader then stipe, to 38 mm wide; context whitish, fistulose, unchanging; universal veil inconspicuous, as a very thin dark ring around the upper part of bulb. ***Partial veil*** apical, membranous, skirt-like, persistent, striate on upper surface, smooth below, whitish, then collapsing on stipe and becoming sordid yellow; edge slightly thickened, pale brownish. **Spore print** white. ***Odor* and *Taste*** not performed.

Microscopic characters — ***Basidiospores*** [90/3/1] (5.3--)5.9--6.6(--7.1) × (5.1--)5.3--5.8(--6.1) µm [**L** = 6.1--6.3 µm; **L’** = 6.2 µm; **W** = 5.4--5.7 µm; **W’** = 5.6 µm; Q = (1.00--) 1.04--1.20(--1.30); **Q** = 1.10--1.14; **Q’** = 1.12], globose to broadly ellipsoid, amyloid, thin-walled, smooth, hyaline; apiculus rather small, sublateral, mostly truncate-conic. ***Basidia*** 25--40(--42) × 10--14 µm, clavate, thin-walled, 4-spored, with stetigmata to 6 µm long; clamps absent. ***Subhymenium*** cellular**,** 30--48 thick, with 3--4(--5) layers of subglobose to ovoid to oblong to broadly ellipsoid cells (11--22 × 9--20 µm), with basidia arising from short ellipsoid cells; basal layer cells arising from broadly inflated elements (terminal or intercalary); ***Lamellar trama*** bilateral, divergent; filamentous hyphae infrequent, 2--9.5 µm wide, branching, hyaline, mostly restrict to mediostratum; inflated cells dominating, terminal or as chain of inflated hyphal segments, pyriform to ellipsoid to clavate to fusoid-ventricose to elongate, to 80 × 23 µm, running parallel or diverging at an angle of ± 30º to the mediostratum; vascular hyphae not observed; clamps absent. ***Marginal tissue of lamellae*** sterile, inflated cells dominating, ovoid to subglobose, to 50 × 40 µm, thin-walled, colorless or nearly so, terminal, single or in pairs on slightly inflated hyphal segments. ***Pileipellis*** 90--140 µm thick, 2-layered; subpellis 35--60 µm thick, non-gelatinized; filamentous hyphae 3--7 µm wide, dominantly subradially arranged, thin-walled, branching, with greyish brown vacuolar pigment; suprapellis 55--80 µm thick, colorless, gelatinized; filamentous hyphae 2.5--5 µm wide, periclinally arranged, branching, thin-walled; vascular hyphae very infrequent, to 10 µm wide. ***Universal veil on pileus*** mainly composed of irregularly arranged elements, with more or less erect-parallel arrangement only distinct in elements close to pileipellis; filamentous hyphae 3--12 µm wide, common, branching, hyaline, thin-walled; inflated cells dominating, mainly globose to subglobose to ellipsoid, but also clavate, ventricose-fusiform or elongate, to 100 x 70 µm, becoming larger near pileipellis, single or in pairs, terminal, mostly distinctly thick-walled (± 1.25 µm thick), some with brownish, granular contents. ***Universal veil*** *absent from stipe base.* ***Stipe trama*** longitudinally acrophysalidic; filamentous scattered to fairly abundant, 2--8 µm wide, branching, thin-walled; acrophysalides dominant, to 320 × 30 µm, long clavate; vascular hyphae rare, 3--10 µm wide; clamp connections not observed. ***Partial veil*** filamentous hyphae 2--5 µm wide, interwoven, branching, fairly abundant; inflated cells dominant, clavate to subfusiform to cylindric, to to 80 × 23 µm, singly terminal directly on filamentous hyphae or connected with these through short inflated segments; vascular hyphae not observed.

Other collections examined -- Brazil: Paraíba, Mamanguape, REBIO Guaribas I, 20 Sep. 2017, leg. C.C. Nascimento CN000 (JPB 00000).

Habit and Habitat -- solitary in sandy soil of native tropical forest on coastal dune (Atlantic rainforest biome).

Etymology -- from Lat., 'griseo' (= cinza) and 'splendida' (= 1. splendid, bright; 2. distinguished, notable).

Known distribution -- Only known from the type locality, in the 'Parque Estadual das Dunas do Natal/Trilha da Geologia', Natal, Brazil.

Remarks – *Amanita griseosplendida* is well circumscribed by its (1) large basidiome, (2) polished to subpolished greyish pileus, (3) concentric arranged, patch-like universal veil remnants composed of distinctly thick-walled (± 1.25 µm thick) inflated cells, (4) conspicuous subglobose bulb**,** and (5) small basidiospores (globose to broadly ellipsoid, **Q'** = 1.12).

Neotropical species in section *Validae* having distinctly small basidiospores and exhibiting some morphological similarities to *A. griseosplendida* are *A. campinaranae* Bas and *A. perphaea* C. Simmons, T. Henkel & Bas, originally described from Brazil and Guyana respectively (Bas 1978, Simmons et al. 2002). *Amanita campinaranae* is most similar but differs from *A. griseosplendida* by its smaller basidiome, not virgate pileus and abrupt basal bulb decorated with a conspicuous greyish volval rim (Bas 1978). Furthermore, *A. campinaranae* displays strictly globose to subglobose basidiospores (Q = 1.0--1.15; **Q** = 1.05; **Q'** = 1.05) (Bas 1978), while those in *A. griseosplendida* are somewhat narrower and range from globose to broadly ellipsoid with a distinctly higher Q value [Q = (1.00--) 1.04--1.20(--1.30) **Q** = 1.10--1.14; **Q'** = 1.12]. *Amanita perphaea* can easily be differenciated from *A. griseosplendida* in having a sulcate-striate pileal margin, universal veil in the form of conical warts and a spindle-shaped bulb (Simmons et al. 2002).

Another Neotropical species that shares some similarities is *A. brunneoloculares* Tulloss, Ovrebo & Hallinge, which also shows (1) basidiomata of large size, (2) a subpolished pileus surface with numerous greyish to brownish patches and (3) similar universal veil remnants on stipe base (Tulloss et al. 1992). However, *A. brunneoloculares* can be distinguished from *A. griseosplendida* by its brownish pileus surface with a red staining reaction when bruised and distinctly larger basidiospores [180/7/4] (6.5--) 7.5--9.8 (--10.8) × (5.0--) 5.8--7.8 (--9.0) µm (Tulloss et al. 1992); or [258/10/6] (6.5--) 7.5--10.0 (--12.5) × (5.0--) 5.8--7.8 (--9.0) µm (Tulloss & Yang 2017).

Compared with species outside the Neotropics, no taxon reported in sect. *Validae* with greyish pileus and spore size and shape similar to that of *A. griseosplendida* was found. *Amanita echinulate* Beeli, *A. pausiaca* Corner & Bas, *A. tristis* Corner & Bas and *A. xanthomargaros* have similar small basidiospores (95th percentile of length less than 6.5 µm), but are macroscopically quite dissimilar from *A. griseosplendida* (Tulloss & Yang 2017).

Amanita melliodora C.C. Nascimento & Wartchow, **sp. nov.**
MycoBank # 000000,

Diagnosis -- Basidiome small-sized. Pileus 40 mm wide, surface greyish yellow, slightly darkening towards the centre, with universal veil as small, scattered, detersile**,** whitish patches; lamellae whitish to yellowish white, unchanging; lamellulae common, subattenuate; basal bulb to 13 mm wide, subglobose, subabrupt, with universal veil forming a whitish rim around top; basidiospores (7.1--)7.7--10.7(--12.2) × (6.1--)6.4--8.2(--8.7) µm, broadly ellipsoid to ellipsoid, occasionally subglobose, amyloid; clamp connections absent. -- Type: Brazil, Paraíba, Mamanguape, REBIO Guaribas I, 20 Jun. 2014, leg. F. Wartchow FW 22/2014 (JPB 00000).

Macroscopic characters — Basidiome small-sized, solitary. ***Pileus*** 40 mm wide, conic flattened; surface greyish yellow (4B4), slightly darkening (5B3--4, grayish orange) towards the centre, with innate, concolor, radiating fibrils; margin entire, nonstriate, nonappendiculate; universal veil as small, scattered, detersile**,** submembranous patches, white (1A1) to dirty white to yellowish white (1A2); context whitish, unchanging, to 4 mm thick above stem, then gradually thinning to midratius, finally abruptly thinning to margin. ***Lamellae*** narrowly adnate, with a very short decurrent tooth, subcrowded, up to 2.5 mm high, yellowish white (1A2); edge entire, smooth, concolorous; lamellulae common, subattenuate, with 2--3 ranks. ***Stipe*** 55 × 10 mm, slightly attenuate upward, flaring at apex; surface smooth, splitting transversely producing rings of recurving scales, white to whitish with cream (4A3) to pale buff (5A2--3) tones after handling; context solid, whitish, unchanging; basal bulb to 13 mm wide, subglobose, slightly flattened longitudinally, subabrupt; universal veil as a thin whitish rim around top of bulb. **Partial veil** superior, submembranous, whitish on upper surface, buff below, very fragile. **Spore print** white to yellowish white. ***Odor*** mild, honey-like. ***Taste*** not performed.

Microscopic characters — ***Basidiospores*** [40/1/1] (7.1--)7.7--10.7(--12.2) × (6.1--)6.4--8.2(--8.7) µm [**L** = 9.4; **W** = 7.0; Q = (1.12--) 1.18--1.50(--1.54); **Q'** = 1.35], broadly ellipsoid to ellipsoid, occasionally subglobose, amyloid, hyaline, smooth, thin-walled, contents granular to guttulate; apiculus sublateral, small, cylindric. ***Basidia*** 35--50(--58) × 9--13(--15) µm, clavate, thin-walled, dominantly 4-, rarely 3- or 2-sterigmate, with stetigmata 3--4 µm long; clamps absent. ***Subhymenium*** 40--50 thick, dominated by inflated cells; with some slightly inflated branched or unbranched elements; cells in 2--3 layers, subglobose to ovoid (12--22 × 7--18 µm) or ellipsoid to short-cylindrical (11--15.5 × 7.5--10 µm) to irregularly shaped. ***Lamellar trama*** bilateral,divergent; mediostratum 38--50 µm thick, filamentous hyphae 2.5--6 µm wide, branching, with some intercalary segments slightly inflated; inflated cells ellipsoid to ovoid to fusiform to elongate, to 80 × 38 µm, as chain of inflated hyphal segments branching off mediostratum at a shallow angle; subhymenial base including chains of narrow cells and slightly inflated hyphal segments, mixed with 3--8 µm wide filamentous hyphae; vascular hyphae not observed. ***Marginal tissue of lamellae*** sterile; inflated cells dominating, mostly clavate to broadly clavate, 28--40 × 12--20 µm, thin-walled, colorless. ***Pileipellis*** to 100 µm thick, 1-leyered, only gelatinized at surface; filamentous hyphae 2--11.5 µm wide, interwoven, branching, subradially oriented, hyaline or sometimes with intracellular yellowish to pale yellowish-brown pigment, thin-walled; vascular hyphae uncommon, 3--5 µm wide. ***Universal veil on pileus*** mainly composed of irregularly arranged elements; inflated cells globose to subglobose, occasionally elongate, to 82 × 79 µm, dominating, terminal, single in chains of 2--4(--5), hyaline to sub-hyaline, thin-walled; filamentous hyphae sparse, 2--11 µm wide, branching, hyaline, thin-walled to slightly thick-walled; vascular hyphae not observed. ***Universal veil*** *absent from stipe*. ***Stipe trama*** longitudinally acrophysalidic; filamentous hyphae common, 3--12 µm wide, branching, hyaline, with walls thin or less than 0.5 µm thick; acrophysalides dominant, to 210 × 40 µm, colorless, with walls thin or up to 0.8 µm thick. ***Partial veil*** not found in the studied dry material.

Habit and Habitat -- solitary on sandy soil in Dense Ombrophilous Forest (Atlantic rainforest biome).

Known distribution -- Only known from the type locality, in the 'REBIO Guaribas I', Mamanguape, Brazil.

Remarks -- *Amanita melliodora* is characterized by its (1) small-sized basidiome; (2) greyish yellow to grayish orange pileus with innate, concolor, radiating fibrils (3) easily detachable universal veil in the form of scattered whitish patches; (3) yellowish white lamellae; (4) subabrupt, subglobose bulb with a thin whitish rim on the top; (5) mostly broadly ellipsoid to ellipsoid basidiospores.

Morphologically, *A. melliodora* is most closely related to *A. flavoconia var. inquinate*, originally described from an oak (*Quercus humboldtii*) forest in Colombia. It resembles *A. melliodora* in having innately virgate pileus surface; easily detachable universal veil in the form of scattered submembranous patches and similar basal bulb. However, *A. flavoconia var. inquinata* can be distinguished by its slightly smaller, globose to broadly ellipsoid basidiospores, having Q = (1.0--) 1.05--1.38 (--1.73); **Q** = 1.12--1.28; **Q'** = 1.20 (Tulloss et al 1992); or Q = (1.0--) 1.06--1.37 (--1.73); **Q** = (1.12--) 1.14--1.28; **Q'** = 1.20 (Tulloss & Yang, 2017).

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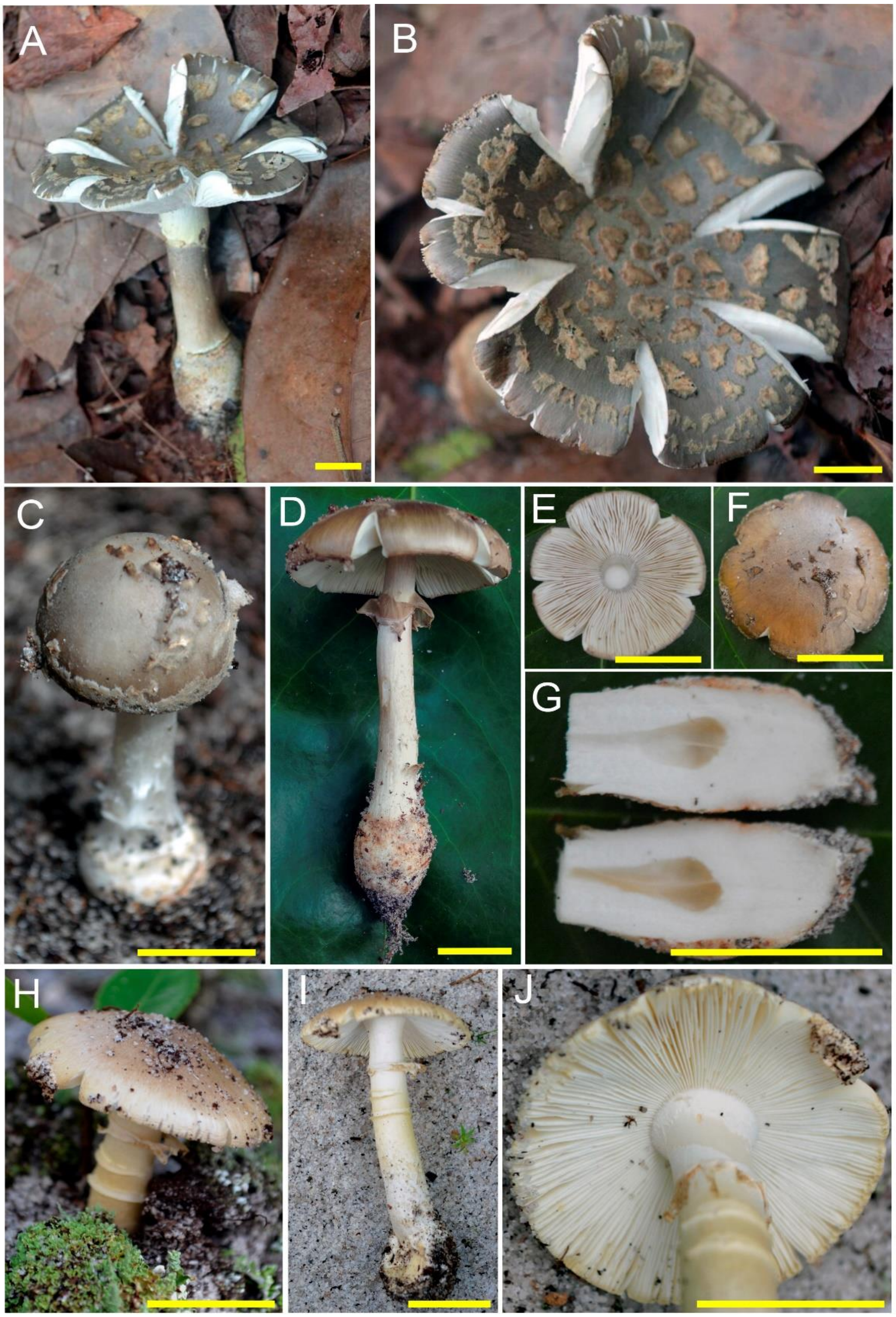
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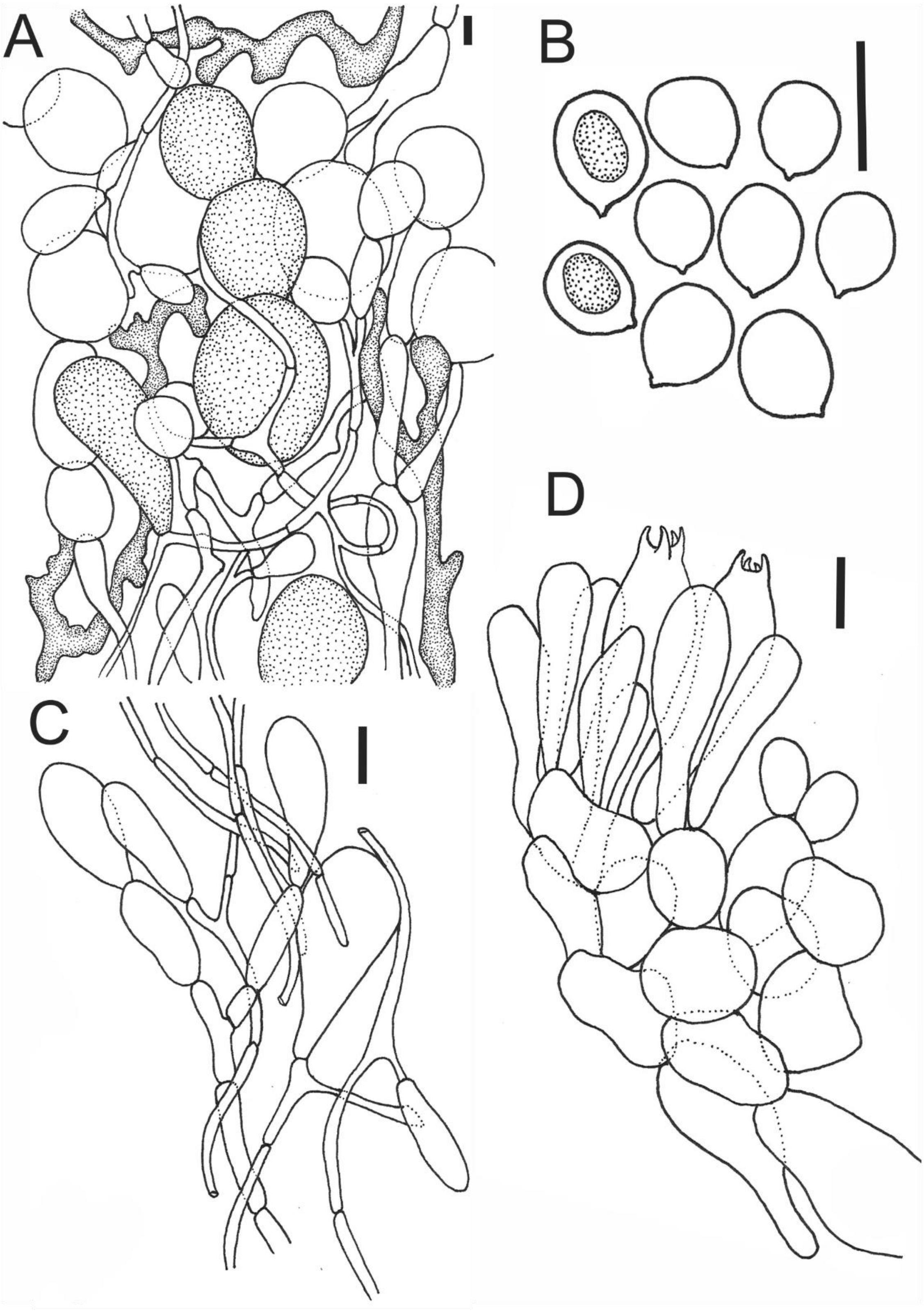
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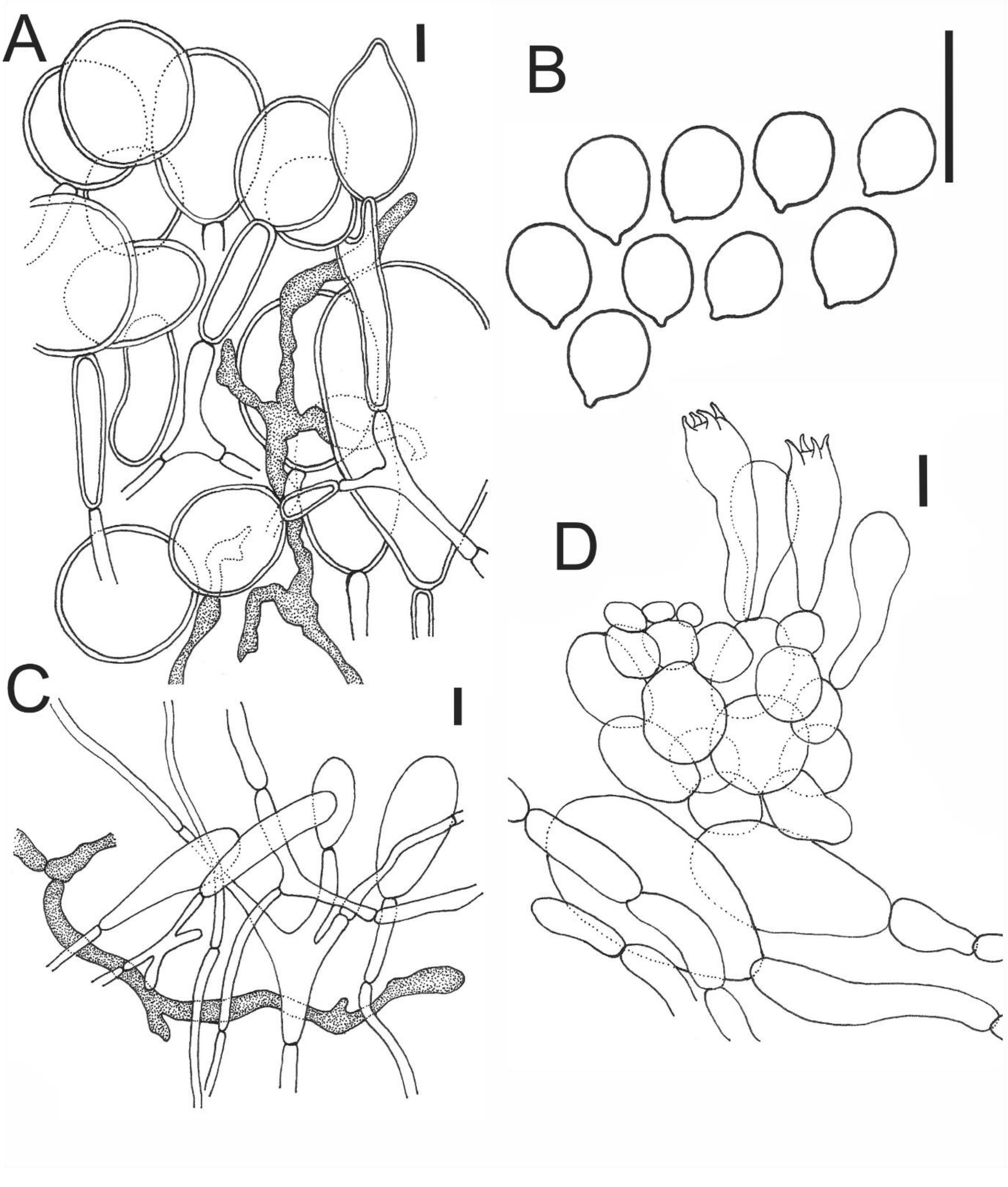
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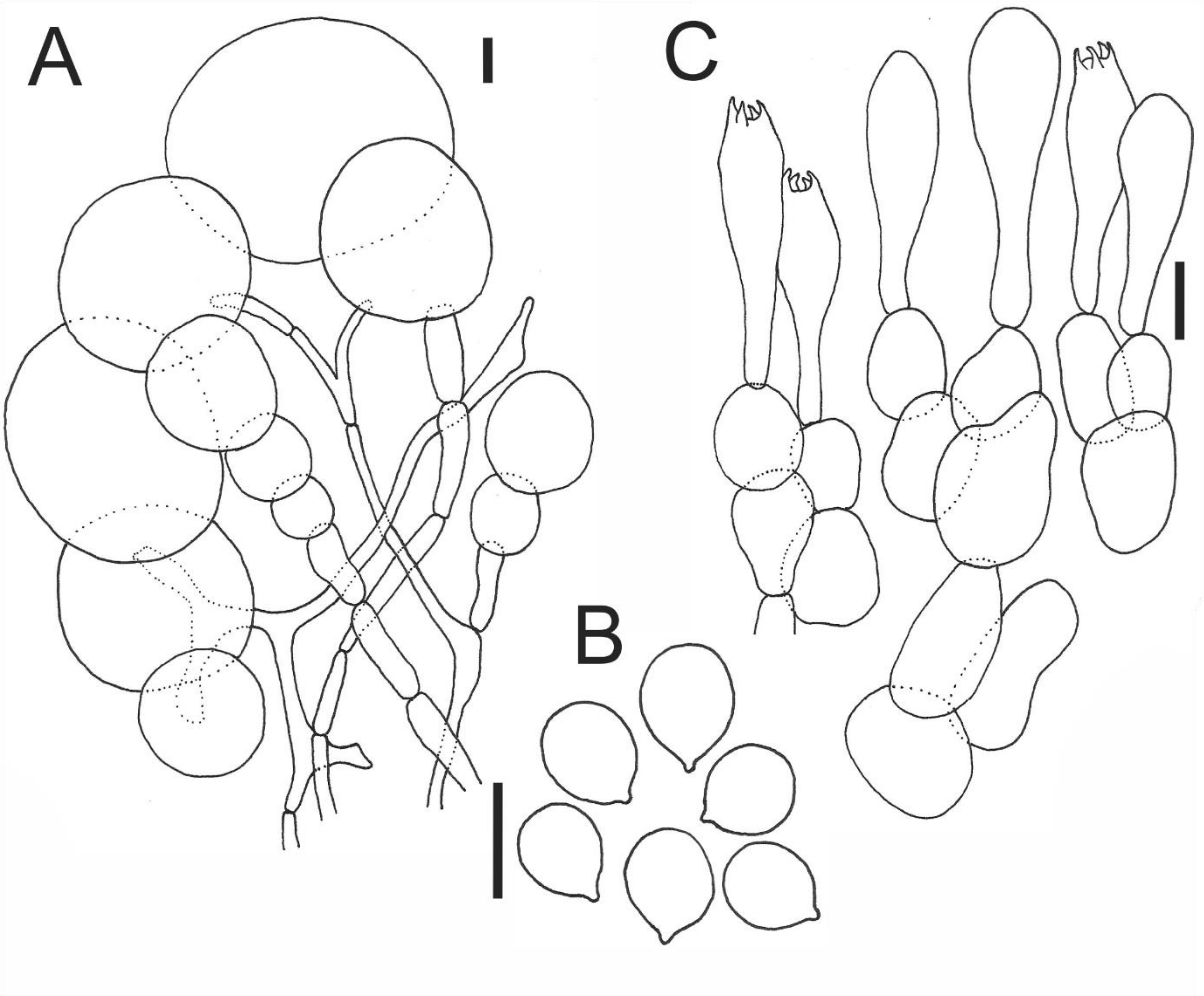
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Figure 1 -- Basidiomata of three new *Amanita* sect. *Validae* from northeast Brazil: A--B, *A. griseobrunnea* (AGS 877); C--G, *A. aureonitida* (CN068); H—J, *Amanita* sp. 1. Scale bars = 20 mm.

Figure 2 -- *Amanita aureonitida*: A, universal veil remnants on pileus in longitudinal section; B, basidiospores; C, partial veil trama; D, hymenium and subhymenium. Scale bars = 10 μm.

Figure 3 -- *Amanita griseosplendida*: A, universal veil remnants on pileus in longitudinal section; B, basidiospores; C, partial veil trama; D, hymenium and subhymenium. Scale bars = 10 μm.

Figure 4 -- *Amanita melliodora*: A, universal veil remnants on pileus in longitudinal section; B, basidiospores; C, hymenium and subhymenium. Scale bars = 10 μm.

APÊNDICE E - ARTIGO 05

New and noteworthy species of *Amanita* from Brazilian Northeast

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Abstract -- This study is a part of an ongoing survey of *Amanita* (Basidiomycota, Amanitaceae) in Brazilian Northeast and presents three new species of *Amanita*: two from sect. *Lepidella*, and one from sect. *Amanita*. In addition we provide the first record of *A. nauseosa* for Brazil.

Keywords – new species, Amanitaceae, morphology, Brazil, taxonomy

INTRODUCTION

Amanita Pers. is a genus with a worldwide distribution (Tulloss 2005; Zhang et al. 2004) and has been classified in the euagaric family *Amanitaceae* E.-J Gilbert of the pluteoid clade (Matheny et al. 2006; Justo et al. 2011). It comprises some of the most conspicuous and beautiful mushrooms in the world, consisting of many well-regarded edible species [e.g. *A. caesarea* (Scop.) Pers., *A. ovoidea* (Bull.) Link, *A. rubescens* Pers.], as well as some deadly poisonous species [e.g. *A. phalloides* (Vaill. ex Fr.) Link, *A. verna* (Bull.) Lam., *A. virosa* Bertill.]. In addition, the genus *Amanita* plays important roles in forest ecosystems, as a large majority of the species are known to be ectomycorrhizal fungi (ECF), being primarily

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associated with *Araucariaceae*, *Betulaceae*, *Dipterocarpaceae*, *Fabaceae*, *Myrtaceae*, *Pinaceae*, and *Salicaceae* (Yang 1997; Weiß et al. 1998; Zhang et al. 2004; Cai et al. 2014).

The genus has been quite extensively studied at both morphologic and molecular levels (Bas 1969; Tulloss et al. 1992; Yang 1997; Weiß et al. 1998; Drehmel et al. 1999; Tulloss et al. 2016; Redhead 2016). It comprises ca. 917 named taxa of which 548 had validly published names (Tulloss and Yang 2017), including primarily agaricoid and a few secotioid and gasteroid forms (Justo *et al*., 2010). Infragenerically, *Amanita* has been split into two subgenera [subgen. *Amanita* and subgen. *Lepidella* (E.-J Gilbert) Veselý] and seven sections [sect. *Amanita*, sect. *Caesareae* Singer, sect. *Vaginatae* (Fr.) Quél., sect. *Amidella* (J.-E Gilbert) Veselý, sect. *Lepidella* sensu Bas, sect. *Phalloideae* (Fr.) Quél and sect. *Validae* (Fr.) Quél.] (Bas 1969; Yang 1997, 2000).

Our continuing studies in *Amanita* in Brazilian Northeast indicate several undescribed taxa are present in this region. In this paper we describe three new species: two from sect. *Lepidella*, and one from sect. *Amanita*. In addition we provide the first record of *A. nauseosa* for Brazil. Previous papers on *Amanita* taxa of the same region include Wartchow & Maia (2007), Wartchow et al. (2007, 2009, 2013a, 2013b, 2015), Menolli et al. (2009) and Wartchow (2016).

MATERIAL AND METHODS

Morphological studies

Macromorphological descriptions were based on field notes and color photographs of basidiomata taken in the field. Colors of fresh and dry basidiomes were compared with reference colors in Kornerup and Wanscher (1978). Observations and measurements reported for micromorphological features were obtained from dried material rehydrated and mounted in distilled water, 3% KOH and Congo red or Melzer's reagent. Regarding biometric values and notation, we follow the emended methodology of Tulloss et al. (1992) and Tulloss (1993, 1994, 2000), which is summarized below.

At the beginning of a set of spore data, the abbreviation [*a/b/c*] signifies "*a*" basidiospores measured from "*b*" basidiomata of "*c*" collections. Dimensions of basidiospores are presented in the following form *(m--) n--o (--p),* in which "*m*" is the smallest value observed or calculated and "*p*" is the largest value observed or calculated. In the range of values observed or calculated, the 5th percentile is "*n*"; and the 95th percentile is "*o*". A summary of definitions of biometric variables follows:

L, (**W**) = the range of average lengths (widths) of spores of each basidioma examined.

L', (**W'**) = the average of all lengths (widths) of spores measured.

Q = the ratio of length to width of a spore or the range of such ratios for all spores measured.

Q = the average of Q computed for all basidiomata examined.

Q' = the average of all Q values computed for all spores measured.

The holotype is kept at the mycological collection of JPB (Thiers, continuously updated).

TAXONOMY

Amanita alboturbinata C.C. Nascimento & Wartchow, **sp**. **nov**. Fig. 1

MycoBank # 000000

HOLOTYPUS – BRAZIL, Rio Grande do Norte, Natal, Parque Estadual das Dunas do Natal (PEDN), 05 Jul. 2017, leg. A.G. Santos AGS860 (JPB). Fig. 1.

Macroscopic characters — Basidiome small-sized. ***Pileus*** 35 mm wide, convex, pure white (1A1), unchanging; *margin* non-striate, appendiculate; *universal veil* as scattered, apressed, submembranous patches, white (2A1) to dirty white (2A2,3A2); *context* up to 1.8 mm thick at stipe, firm, white to whitish, unchanging, turning gradually thinning toward margin. ***Lamellae*** subfree, with short decurrent tooth at stipe apex, crowded, white (1A1), unchanging; *margin* serrated to occasionally slightly eroded, concolorous, up to 3 mm diam. (at midratius); *lamellulae* sub-truncate to truncate, with 3--4 lengths, plentiful, unevenly distributed. ***Stipe*** 45 (excluding bulb) × 7 mm (at midstipe), concolor with pileus, with flattened squamules (sometimes in zig-zag pattern) below partial veil; *bulb* marginate, broadly obconic, 18 × 15 mm wide; *context* solid, white to whitish, unchanging; *universal veil* as a free, very narrow, submembranous volval limb which is separated from the stipe by a circular groove. ***Partial veil*** apical, pendent, membranous, double, white (1A1), striate above, fibrillose-lacerate below. ***Odor* and *taste*** not recorded.

Microscopic characters — ***Basidiospores*** [40/1/1] (8.2–)9–11.2 (–12.5) × (5.5–) 6,2–9 (–9.8) µm; [**L** = 9.7 µm; **W** = 7.8 µm; Q = 1.23–1.54 (–1.61); **Q** = 1.30], broadly ellipsoid to ellipsoid, rarely elongate, hyaline, thin-walled, smooth, amyloid; apiculus prominent, cylindric; contents monoguttulate or occasionally granular. ***Basidia*** 38–45 × 8–11.5 µm, clavate, 4-spored, clampless. **Subhymenium** inflated-ramose to subcellular. ***Lamellar trama*** bilateral divergent, with elongate cell to 40 µm wide. ***Lamellar edge tissue*** composed of mainly piriform cells 25–60 × 12–38 µm. **Pileipellis** hyaline or almost so, rather thin, 25–80 µm thick, distinctly gelatinized at surface; filamentous hyphae 2.0–10.5 µm wide, branching, mostly subradially oriented; vascular hyphae not observed. ***Universal veil on pileus*** composed of loosely interwoven, branching hyphae 2.5–12 µm wide, dominant especially in the outer layer; inflated cells subcylindrical to clavate to piriform to ellipsoid (to 88 × 35 µm), singly or as short to rather long, irregularly disposed rows; branching elements sometimes slightly inflated. ***Stipe context*** acrophysalidic; filamentous hyphae 2–8.5 µm, fairly abundant; acrophysalides 80–112 × 9–13 µm; vascular hyphae 4–10, µm rare.

Habit and Habitat – Solitary in sandy soil of native tropical forest on coastal dune (Atlantic rainforest biome).

Known distribution – Only known from the type locality, in the ‘Parque Estadual das Dunas do Natal, Natal (RN), Brazil.

Remarks – *Amanita alboturbinata* is assignable to *Amanita* subgen. *Lepidella*, sect. *Lepidella*, subsect. *Limbatulae* Bas due to its distinctly marginate basal bulb, amyloid basidiospores, and the universal veil in form of scattered submembranous patches on pileus and as a submembranous limb at bulb, with outer layer always dominated by disordered filamentous hyphae (Corner & Bas 1962, Bas 1969).

Whitin subsect. *Limbatulae*, *A. alboturbinata* fits in the stirps *Preissii*, which is characterized by clampless basidia and broadly ellipsoid to elongate basidiospores that are longer than 8 µm (Bas 1969). In this stirps the most morphologically similar species is *A. sublutea* (Cleland) E.-J. Gilbert, which share several characters with *A. alboturbinata*, such as a small basidiome, a marginate bulb, spores reaching more than 10 µm and a very similar universal veil anatomy. However, *A. sublutea* can easily be distinguished from *A. alboturbinata* by its pale buff basidiomata, exannulate stipe and elongate to rarely cylindrical basidiospores (Q = (1.5–)1.65–2.05; **Q’** = 1.8) (Bas 1969, Tulloss & Yang 2017)

Amanita flavosulcatissima C.C. Nascimento, V.R.M. Coimbra & Wartchow, **sp**. **nov**.
Fig. 1

MycoBank # 000000

HOLOTYPUS – BRAZIL, Pernambuco, Tamandaré, REBIO Saltinho, 03 July 2011, leg. V.R.M. Coimbra & L.S. Araújo-Neta (URM 84452).

Macroscopic characters — Basidiomes small to medium-size, solitary. ***Pileus*** 15–46 mm wide, first globose to sub-globose to nearly hemispheric, then becoming convex to plano-convex, occasionally with a depressed disc; surface dry, dull, subglabrous to glabrous, light yellow (1A5) to greenish yellow (1A8) to vivid yellow (2A8) fading to yellowish white (milk white, 1A2) towards the margin, unchanging; *margin* strongly sulcate-striate (0.5R–0,75R), incurved at first, then becoming somewhat decurved, acute serrate to eroded, occasionally rimose, appendiculate; *universal veil* as minute farinose warts, pale yellow to yellow to dirty yellow (yellowish white, pale yellow, pastel yellow, 3A2-4), concentrically arranged, detersile, unchanging; *context* soft, fragile, rather thin in limb, creamy white to yellowish white (1A2), unchanging. ***Lamellae*** subclose to close, subventricose, dull white (1A1) to off-white in mass, unchanging when cut or bruised; margin smooth to serrate, concolorous; *lamellulae* subattenuate to attenuate, with 2-3 lengths, unevenly distributed, fairly abundant. ***Stipe*** 47–65 × 5–9 mm, central, cylindric, flaring at apex; surface entirely finely cottony pruinose, creamy white to yellowish white (1A2) to pale yellow (1A3); *basal bulb* subglobose to ovate, up to 14 mm; *context* stuffed or hollow, concolorous with pileus context, unchanging; *universal veil on stipe base and bulb* as scattered, rather fragile, farinose squamules, occasionally forming irregular rings on the upper half of the bulb, concolorous with the universal veil on cap. ***Partial veil*** lacking. ***Odor* and *taste*** not recorded.

Microscopic characters — ***Basidiospores*** [90/3/2] (5.0–) 6.0–7.5 (–8.0) × 4.0–5.5(–6.3) µm [**L** = 6.5–6.9 µm; **L'** = 6,7 µm; **W** = 4.6–5.0 µm; **W'** = 4.8µm; Q = 1.09–1.48(–1.66); **Q** = 1.18–1.37 (–1.4); **Q'** = 1.30], subglobose to ellipsoid, rarely elongate, hyaline, thin-walled, smooth, amyloid; apiculus prominent, cylindric; contents monoguttulate or occasionally granular. ***Basidia*** 43–55 × 8–12 µm, narrowly clavate, hyaline, thin-walled, 4-spored, with sterigmata to 7 × 3 µm; contents with scattered granules; basal septa clampless. ***Subhymenium*** 25–45 µm, in 2 to 3 layers of subglobose, ovoid to irregularly shaped cells (10–20 × 8–16.5 µm), dominating, some uninflated branched or unbranched elements occasionally present. ***Lamellar trama*** bilateral, divergent; mediostratum 30–40 µm wide, composed of hyaline, thin-walled, filamentous undifferentiated hyphae 3–6.5 µm wide, with occasional slightly inflated intercalary narrowly fusiform elements (up to 65 × 13.5 µm); vascular hyphae 3.5–12 µm wide, branching, uncommon to locally common; lateral stratum containing long ellipsoid to fusiform or clavate-cylindrical inflated cells (45–90 × 18–27 µm); filamentous undifferentiated hyphae 3.5–7.5 µm wide, abundant to fairly abundant. ***Lamellar edge tissue*** sterile, predominantly composed of inflated cells, ovoid to subglobose or pyriform [(10–)12–20 × 9.5–16 µm], disarticulating; filamentous undifferentiated hyphae, scattered, 2–7.5 µm wide, thin-walled, hyaline or with yellowish vacuolar pigments. ***Pileipellis*** 65–95 µm thick, 2-layered; suprapellis 15–20 µm thick, extensively gelatinized, hyaline, colorless; subpellis pale yellowish, 50–75 µm thick, non-gelatinized; filamentous undifferentiated hyphae 3.0–12 µm wide, branching, dominating, subradially oriented; vascular hyphae not observed. ***Universal veil on pileus*** composed of abundant mainly ellipsoid to globose, but also piriform, clavate, ventricose-fusiform or elongate cells; 20–65 × 18–55 µm, terminal or forming chains of 2–3, with cells in such chains often easily dissociating, from nearly colourless to pale yellow; elements irregularly disposed; filamentous undifferentiated hyphae 3–12 µm, branching, hyaline, colorless or occasionally with intracellular pale yellowish-brown pigment; vascular hyphae not observed. ***Universal veil on stipe base*** very similar to material on pileus. ***Stipe context*** longitudinally acrophysalidic; filamentous hyphae 3–11 µm wide, thin-walled; acrophysalides very narrowly clavate to clavate, up to 187 × 45 µm, thin-walled; vascular hyphae scarce; clamps not observed.

Other collections examined – **Brazil:** Pernambuco, Tamandaré, REBIO Saltinho, 05 Sep. 2011, V.R.M. Coimbra & L.S. Araújo-Neta, s/n (URM 84453).

Habit and Habitat – Growing in soil, solitary or cespitose, in groups of few individuals. It is possibly an ectomycorrhizal species.

Known distribution – Presently known only from 'REBIO Saltin ho', Tamandaré (PE), northeast Brazil.

Remarks – *Amanita flavosulcatissima* belongs to subgenus *Amanita*, section *Amanita*, which is characterized by the inamyloid basidiospores, bulbous stipe base and usually friable universal veil remnants (Corner & Bas 1962, Bas 1969). Within sect. *Amanita*, *A. flavosulcatissima* fits in the subsection *Amanitella*, which is characterized by the pulverulent universal remnants veil on the upper surface of the stipe's basal bulb, and the absence of clamps on the basidia basal septa (Bas 1969).

The new species is easily recognized by the combination of the following characters: (1) yellowish to greenish yellow pileus, (2) strongly sulcate-striate margin (0.5R–0,75R), (3) yellowish universal veil in form of minute farinose warts or squamules, (4) subglobose to ellipsoid, rarely elongate basidiospores [Q = 1.09–1.48(–1.66); **Q** = 1.18–1.37 (–1.4); **Q'** = 1.30]. Morfologically, *A. flavosulcatissima* is most closely related to *A. xerocybe* Bas. However, *Amanita xerocybe*, originally described from Amazonian Brazil, and later reported from Pakaraima Mountains of western Guyana, clearly differs from *A. flavosulcatissima* in having a yellowish brown to brownish pileus with a low obtuse umbo, an apical partial veil (thickish and fluffy), and broader basidiospores [49/3/3] 6.0–9.0 × 6.0–8.6 (–9.4) µm, (Q = 1.0–1.10; **Q** = 1.03–1.04) (Bas 1978, Simmons et al. 2002).

Amanita aureonauseosa C.C. Nascimento & Wartchow, **sp. nov.** Fig. 1
MycoBank # 000000

Holotype: BRAZIL. Ceará, Ubajara, Parque Nacional de Ubajara, 20 Jan.2014, F. Wartchow & M.C.A. Sá. FW 06/2014 (JPB).

Macroscopic characters — Basidiome small-sized to medium, solitary. ***Pileus*** 48–60 mm wide, globose to rounded-conic with an incurved margin at first, becoming planar to plano-depressed or having margin uplifted in maturity; surface having dry bright appearance until age, glabrous, finely pruinose (especially over disc), butter yellow (4A5) to buttercup yellow (4A7), *margin* non-striate, slightly appendiculate when young; *universal veil* as detersile, crumb-like warts (some rather broad and irregular, some small and rounded), randomly arranged, densely placed over disk, soft-squamulose near margin, concolor with pileus surface to somewhat yellowish white (1A2); *context* up to 7 mm thick at stipe, thinning evenly towards the margin, firm, yellow (3A3) to pale yellow just beneath pileipellis, white to pale sordid white to yellowish white elsewhere. ***Lamellae*** subfree to narrowly adnate, close to subcrowded, lacking decurrent lines on stipe apex, pale yellow (3A3), relatively thick 5–9 mm broad, subventricose, entire, unchanging when cut or bruised, with a thin paler edge; *lamellulae* subatenuate to attenuate to attenuate in steps, of diverse lengths, unevenly distributed. ***Stipe*** 70–100 × 10–12 mm, with ground color pale yellow (3A3) to buff to yellowish white (1A2) to off-white, bruising light orange (5A4-5) where handled, cylindric to subcylindric to narrowing downward, broadest near the apex; *bulb* lacking or with a subbulbous base (seen in only one basidiome), 15 mm wide; *context* white to pale yellow (2A2), slowly becoming yellow-orange (4A3) to light orange (5A4-5) on cut surfaces, solid; *universal veil* in the upper stipe as overlapping rows of fragile, lanose, upward-pointing squamules, elsewhere as scattered to locally conspicuous lanose-squamulose to floccose-squamose remnants, light yellow (1A4) to primrose yellow (1A6) to poison yellow (1A8) to vivid yellow (3A8). ***Partial veil*** very weakly submembranous, hanging like ragged skirt, fibrillose beneath. ***Odor*** penetrating, extremely unpleasant, nauseating, even in dry material. ***Taste*** not recorded.

Microscopic characters — ***Basidiospores*** [90/2/1] (9.2–) 9.6–12 (–12.5) × (8.8–) 8.8–11 (–11.5) µm; [**L** = 10.2–10.8 µm; **L'** = 10.5 µm; **W** = 9.6–10 µm; **W'** = 9.8 µm; Q = 1.0–1.13 (–1.15); **Q** = 1.04–1.10; **Q'** = 1.06], globose to subglobose, hyaline, thin-walled, smooth, amyloid; apiculus prominent, truncate; contents monoguttulate. ***Basidia*** 30–65 (–68) × 7–11.0 (–13) µm, clavate, thin-walled, yellowish contents in 3% KOH, dominantly 4-spored, occasionally 2- or 3-spored, sterigmata up to 5 µm long; basal septa often clamped. ***Subhymenium*** 25–40 µm thick, ramose to inflated ramose. ***Lamellar trama*** bilateral, markedly divergent; mediostratum 40–70 (–80) µm wide, composed largely of filamentous, undifferentiated hyphae 2.0–14 µm wide; intercalary inflated cells infrequent, thin-walled, mostly clavate to ellipsoid (46 × 20.5 µm) to fusiform; vascular hyphae up to 10.5 µm wide, infrequent; septa often with clamps; lateral stratum made up of curved intercalary inflated cells (up to 90 × 20 µm), mixed with abundant, filamentous, undifferentiated hyphae 3.0–12.5 (–16) µm wide, diverging at an angle of 45°–60° to the central stratum; vascular hyphae up to 12 µm wide; septa often with clamps. ***Lamellar edge tissue*** sterile composed of inflated cells and filamentous hyphae; inflated cells clavate to broadly clavate (25–35 × 8–18 µm) or ovoid to subglobose (20–38 × 15–22 µm), thin-walled, hyaline, disarticulating at septa; filamentous hyphae scattered to fairly abundant, 2.5–4 wide, thin-walled, hyaline, often clamped; vascular hyphae not observed. ***Pileipellis*** difficult to delimit, not gelatinized, consisting of a yellowish-orange layer of repent, interwoven hyphae 3.0–12 µm wide. ***Universal veil on pileus*** composed of chains (readily disjoining) of mainly subcylindrical, elongate-fusiform, slendery clavate, and ellipsoid cells, 40–92 x 10.8–32 µm, irregularly disposed; filamentous hyphae 2.2–13 wide, scattered; vascular hyphae mot observed. ***Universal veil on stipe*** somewhat similar to pileus remnants. ***Stipe context*** longitudinally acrophysalidic; acrophysalides to 180 × 40 µm.

Habit and Habitat – Growing scattered in soil, near water courses.

Known distribution -- Presently known only from 'Parque Nacional de Ubajara', Ubajara (CE), northeast Brazil.

Remarks – *Amanita aureonauseosa* is well circumscribed by its small to medium-sized basidiomata; vivid yellowish pileus; easily detachable universal veil in form of yellowish white crumb-like warts or soft squamules which are composed of chains (readily disjoining) of mainly subcylindrical, elongate-fusiform, slendery clavate, and ellipsoid cells; an inconspicuous basal bulb; a white to pale yellow context, slowly becoming yellow-orange to light orange on cut surfaces; the common presence of clamps at the basal septa of basidia and an extremely unpleasant (nauseating) odor. It is assignable to *Amanita* sect. *Lepidella* (subgen. *Lepidella*), which is characterized by the amyloid basidiospores, appendiculate pileus margin and friable universal veil (Corner & Bas 1962, Bas 1969).

Amanita aureonauseosa may be keyed out in the *Amanita* subsect. *Vittadiniae* Bas stirps *Nauseosa* due to its inflated cells of the universal veil on the pileus that are cylindric, elongate-fusiform or clenderly clavate and arranged in chains; clamped basidia; friable universal veil remnants; small basal bulb; globose to subglobose basidiospores (**Q** = 1.04–1.10) and odor extremely unpleasant. Among the species in stirps *Nauseosa,* the Asian *A. flavofloccosa* Nagas. & Hongo exhibits closest similarity to the new species, but differs from *A. aureonauseosa* in having broader basidiomata and whitish pileus surface, unchanging context, and smaller basidiospores [-/1/1] 7–8 (-9) × 6–8 µm, [Q = 1.0–1.2 (–1.3)] (Nagas. & Hongo 1984)

Other somewhat similar taxon (but without clamps at the bases of basidia) is *A. aureofloccosa* (stirps Thiersii). *Amanita aureonauseosa* and *A. aureofloccosa* share similar yellowish basidiomata and globose to subglobose basidiospores [90/2/2] (5.5–)6.5–10.5(–11.0) × (5.5–) 6.5–10.0(–11.0) µm, Q = (1.00–)1.02–1.13(–1.14); **Q** = 1.04–1.05, **Q'** = 1.04) (Wartchow & Cortez 2015); [20/1/1] (6.0–) 7.0–8.5 (–9.0) × (6.0) 6.5– 8.5 µm, (Q = 1.0–1.10) (Bas 1969). However, *A. aureofloccosa* is differentiated from *A. aureonauseosa* by its floccose-pulverulent universal veil remnansts distributed over all stipe surface and distinctly thick-walled basidiospores.

Amanita nauseosa (Wakef.) D.A. Reid, Nova Hedwigia 11: 25 (1966) Fig. 2

= ***Lepiota nauseosa*** Wakef., Bulletin of Miscellaneous Informations of the Royal Botanical Gardens Kew 1918: 230 (1918).
= ***Aspidella nauseosa*** (Wakefield) Vizzini & Contu, Micologia e Vegetazione Mediterranea 27 (2): 83 (2012).
= ***Saproamanita nauseosa*** (Wakefield) Redhead, Vizzini, Drehmel & Contu, IMA Fungus 7 (1): 123 (2016).

Macroscopic characters — Basidiomes medium-sized to large. ***Pileus*** 50–180 mm wide, at first nearly hemispherical, then convex to plano-convex, often with low and broad umbo; surface dry, slightly viscid when wet, strongly fibrillose, white (1A1) to dirty white to cream (4A3) to orange white (5--6A2) to pale orange (5--6A3) to Salmon (6A4); *margin* nonstriate, appendiculate, at first inflexed, then straight, sometimes radiately rimose; *universal veil* whitish to pale yellowish to cream (4A2), later yellowish brown (5D8) to brownish orange (6C8) to light brown (6D8), as a powdery-floccose covering at first, then breaking up into concentrically arranged low scales or into polygonal to irregular patches, finally becoming almost absent as scattered, floccose-fibrillose scales; *context* to 13 mm thick, white (1A1) to yellowish, unchanging. ***Lamellae*** free, close to subcrowded, white (1A1) to yellowish (1A2), unchanging, with entire edge; *lamellulae* attenuate to subattebuate. ***Stipe*** 80–195 × 9– 20 mm, subcylindric to narrowing downward, flaring at the apex, concolor with pileus; *bulb* very small or absent; *context* white (1A1) to yellowish, solid; *universal veil* present as pulverulent-floccose material, is densest on the upper stipe, and inconspicuous on the lower part, concolor with pileus universal veil remnants. ***Partial veil*** pulverulent-flocose, disrupting. ***Odor*** penetrating and highly unpleasant. The odor persists in dried specimens of the present species. ***Taste*** not recorded.

Microscopic characters — ***Basidiospores*** [210/7/3] (7.2–) 7.8–11 (–14.0) × (5.5–) 6.5–9 (12.2) µm; [**L** = 8.2–9.8 µm; **L’** = 9.0 µm; **W** = 6.9–8.5 µm; **W’** = 7.8 µm; Q = (1.00–)1.04–1.42 (–1.82); **Q** = 1.8–1.35; **Q’** = 1.18]. ***Basidia*** 28–55 (–60) × 6–11 (–14) µm, clavate, thin-walled, 4- or occasionally 3- or 2-spored, clamped. ***Subhymenium*** consisting of a frequently branching structure of partially inflated segments subtended by irregular inflated cells. ***Lamellar trama*** bilateral divergent, central stratum 25–38 µm thick; angle of divergence shallow; filamentous, undifferentiated hyphae 1.5–7.5 µm wide, branching, interwoven; intercalary inflated cells ellipsoid to ovoid to broadly clavate, to 96 × 38 µm; vascular hyphae 3–8 µm wide, uncommon. ***Lamellar edge tissue*** not found. ***Pileipellis*** indistinct, trama of pileus gradually passing into universal veil remnants on pileus surface. ***Universal veil on pileus*** composed of irregularly arranged elements; inflated cells subcylindrical to broadly fusiform to slenderly fusiform to elongate elliptic to long clavate elements, 125 × 36 µm, walls thin to slightly thickened (±0,5 µm thick), terminal and in chains, disjoining; filamentous hyphae 2–9.5 µm wide, branching, hyaline, scattered to fairly abundant. ***Universal veil on stipe*** similar to pileus remnants. ***Stipe context*** longitudinally acrophysalidic; acrophysalides thin-walled, abundant to 280 × 40 µm; vascular hyphae not observed.

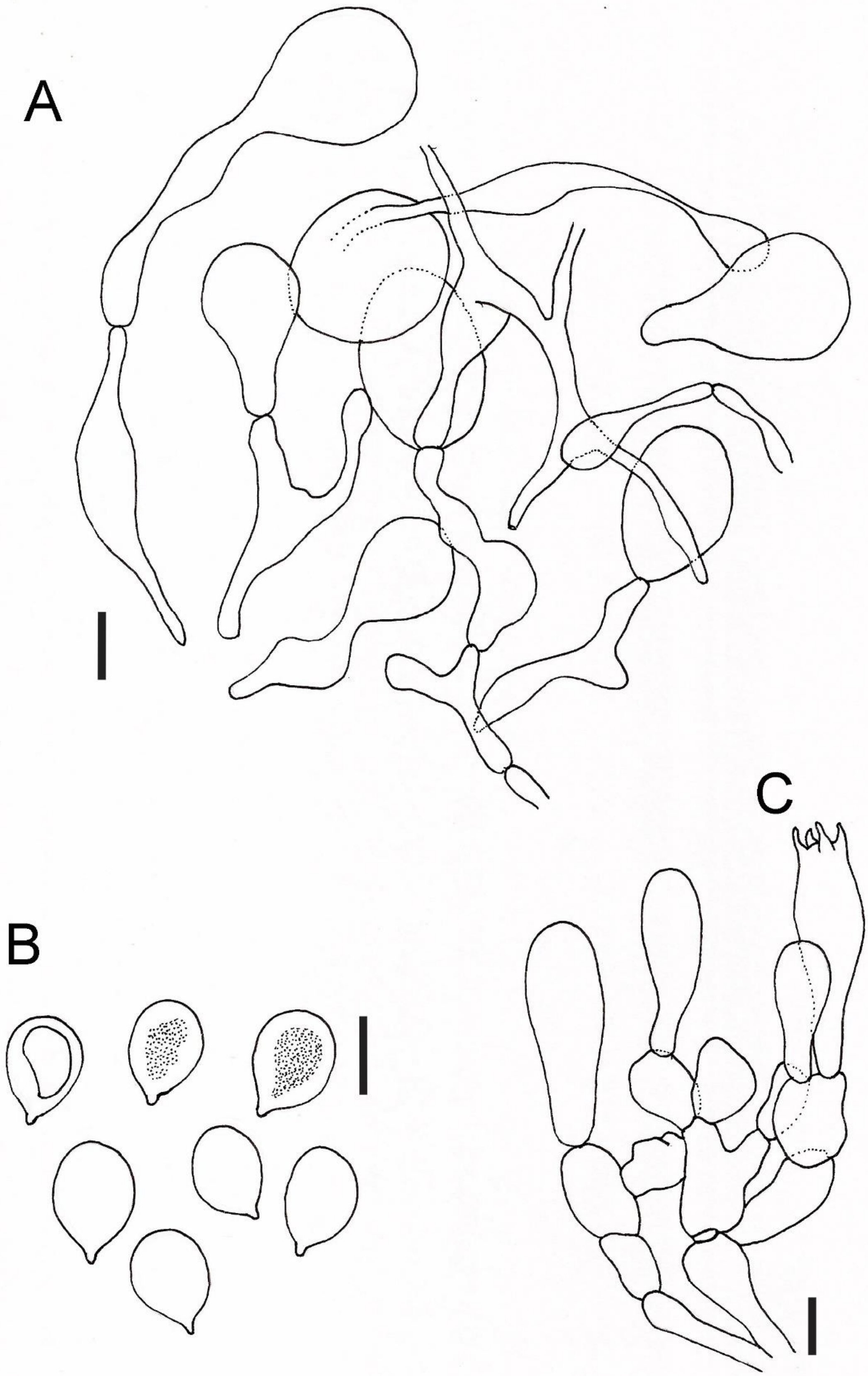
Collections examined – Brazil: **Paraíba**, João Pessoa, Portal do Sol, 20 Jun. 2015, Wartchow F., FW 20/2015 (JPB); **Pernambuco**, Recife, *Campus* da Universidade Federal de Pernambuco, 27 May 2014, Wartchow F., FW 27/2014 (JPB); **Rio Grande do Norte**, Natal, Parque Estadual das Dunas do Natal (PEDN), 18 May 2011, Sulzbacher M., 309 (UFRN-Fungos 1874).

Habit and Habitat – Solitary to gregarious. *Paraíba* and *Pernambuco*: in lawn, not associated with any tree species; *Rio Grande do Norte*: in sandy soil of native tropical forest on coastal dune.

Known distribution – Brazil; Martinique; Mexico, U.K. (England, Scotland); U.S.A. (Florida, Maryland, Mississippi, Texas).

Remarks – The present species is one of the taxa of sect. *Lepidella* that are found growing without any apparent woody plant symbiont (Tulloss & Yang 2017, Wolf et al. 2012). It was originally described from a greenhouse in the Botanical Gardens at Kew. It is also known to have occurred in the Botanical Gardens at Edinburgh and in Mexico City. The natural range of the species appears to lie in the Caribbean Region: both in the island nations and in the states of Mexico and the U.S.A. along the Gulf of Mexico (Bas 1969, Jenkins 1979, Pegler 1983, Tulloss & Yang 2017).

Herein *Amanita nauseosa* is reported for the first time from South America, at the states of Paraíba, Pernambuco e Rio Grande do Norte, Brazil. It belongs to subsect. *Vittadiniae* stirps *Nauseosa* in the taxonomic scheme of Bas (1969). The most similar taxa reported in the literature are *A. roseolescens*, described from South Africa and most recently reviewed by Reid and Eicker (1991), and *A. foetidissima* D. A. Reid & Eicker, described from South Africa and later reported from Zambia by Pegler and Shah-Smith (1997).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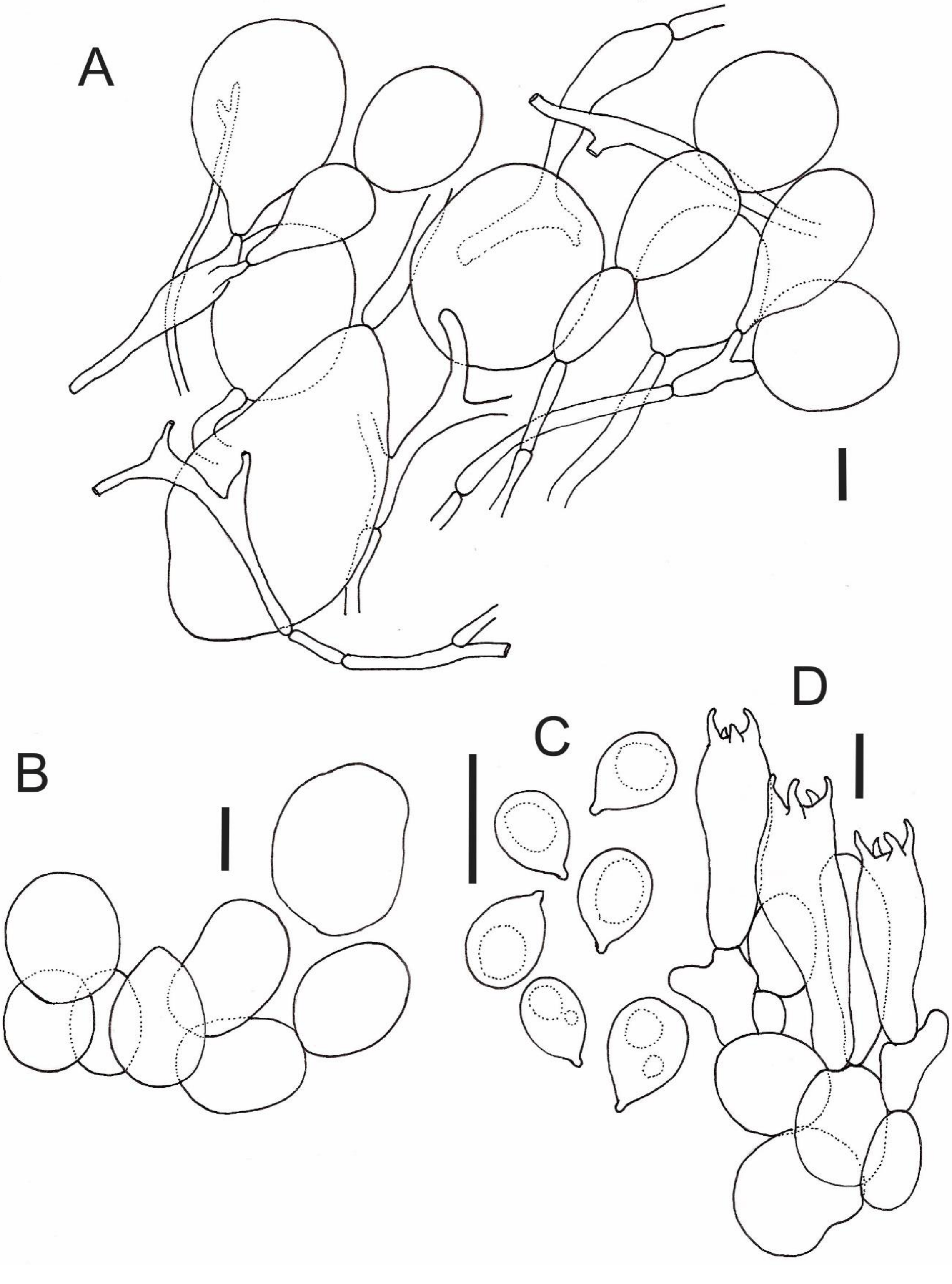
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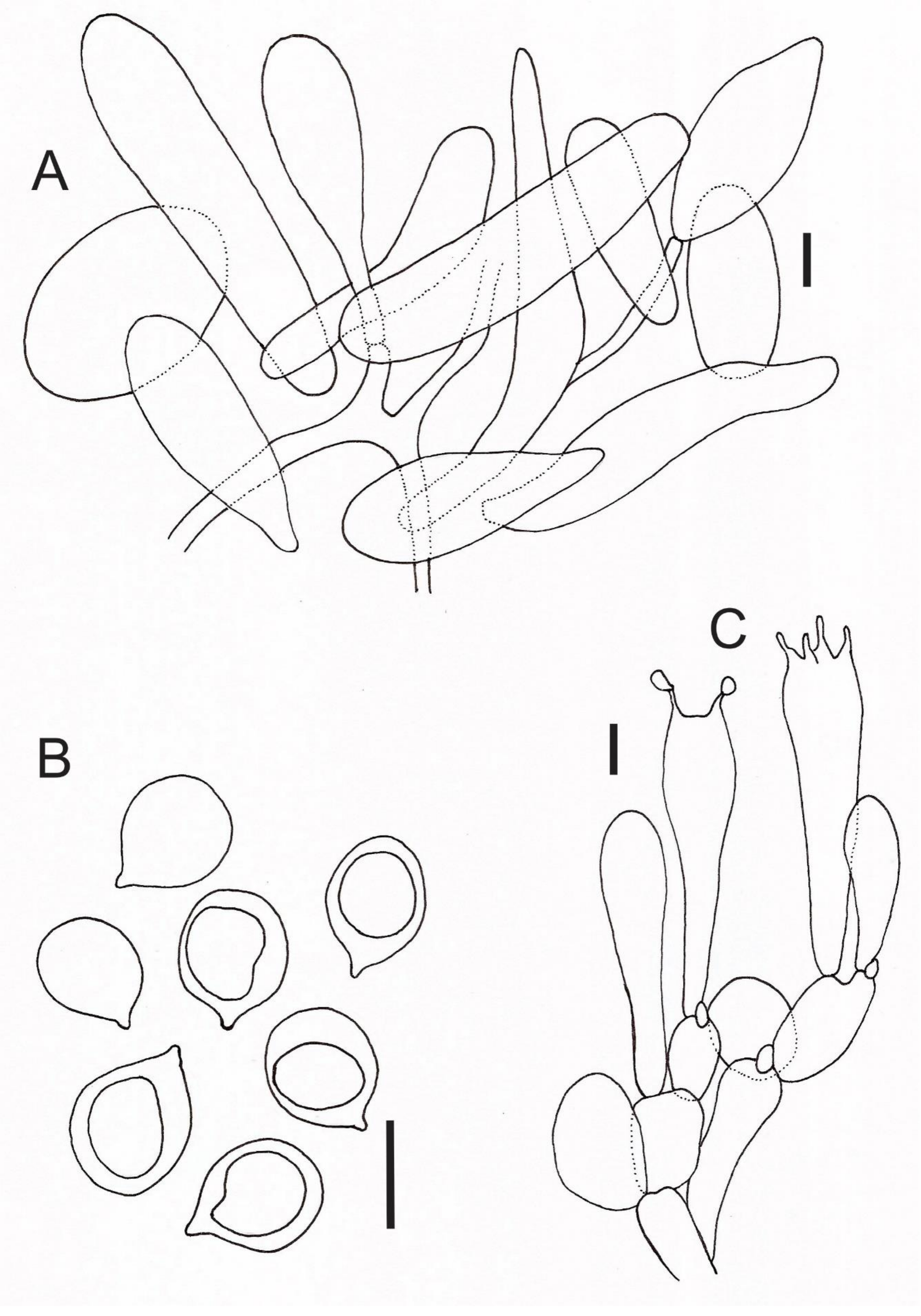
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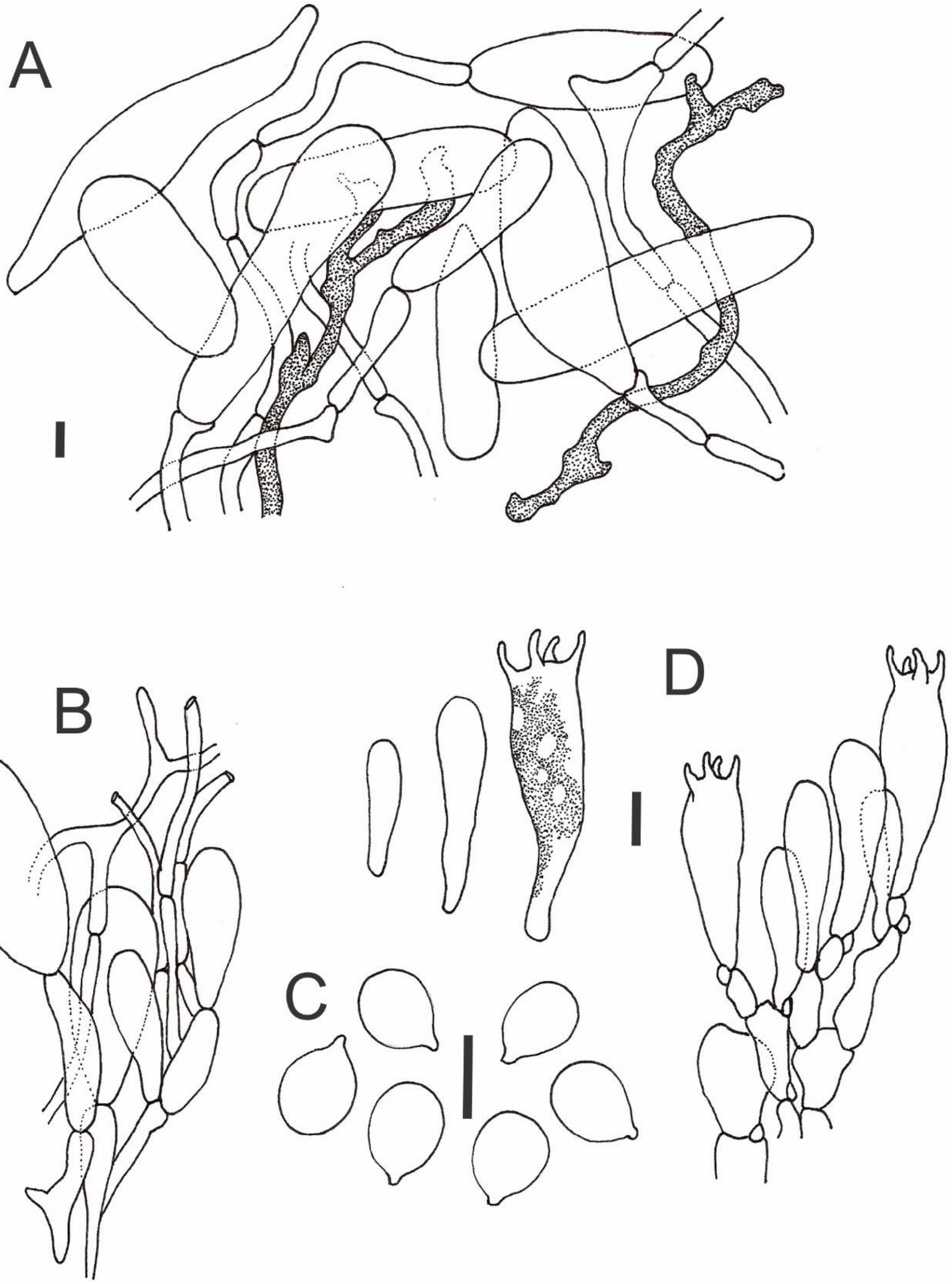
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Figure 1 -- *Amanita alboturbinata*: A, universal veil remnants on pileus; B, basidiospores; C, hymenium and subhymenium. Scale bars = 10 µm.

Figure 3 -- *Amanita flavosulcatissima*: A, universal veil remnants on pileus; B, cells of lamellar edge tissue; C, basidiospores; D, hymenium and subhymenium. Scale bars = 10 µm.

Figure 3 -- *Amanita aureonauseosa*: A, universal veil remnants on pileus; B, basidiospores; C, hymenium and subhymenium. Scale bars = 10 µm.

Figure 4 -- *Amanita nauseosa*: A, universal veil remnants on pileus; B, parcial veil trama; C, basidiospores; D, hymenium and subhymenium. Scale bars = 10 µm.

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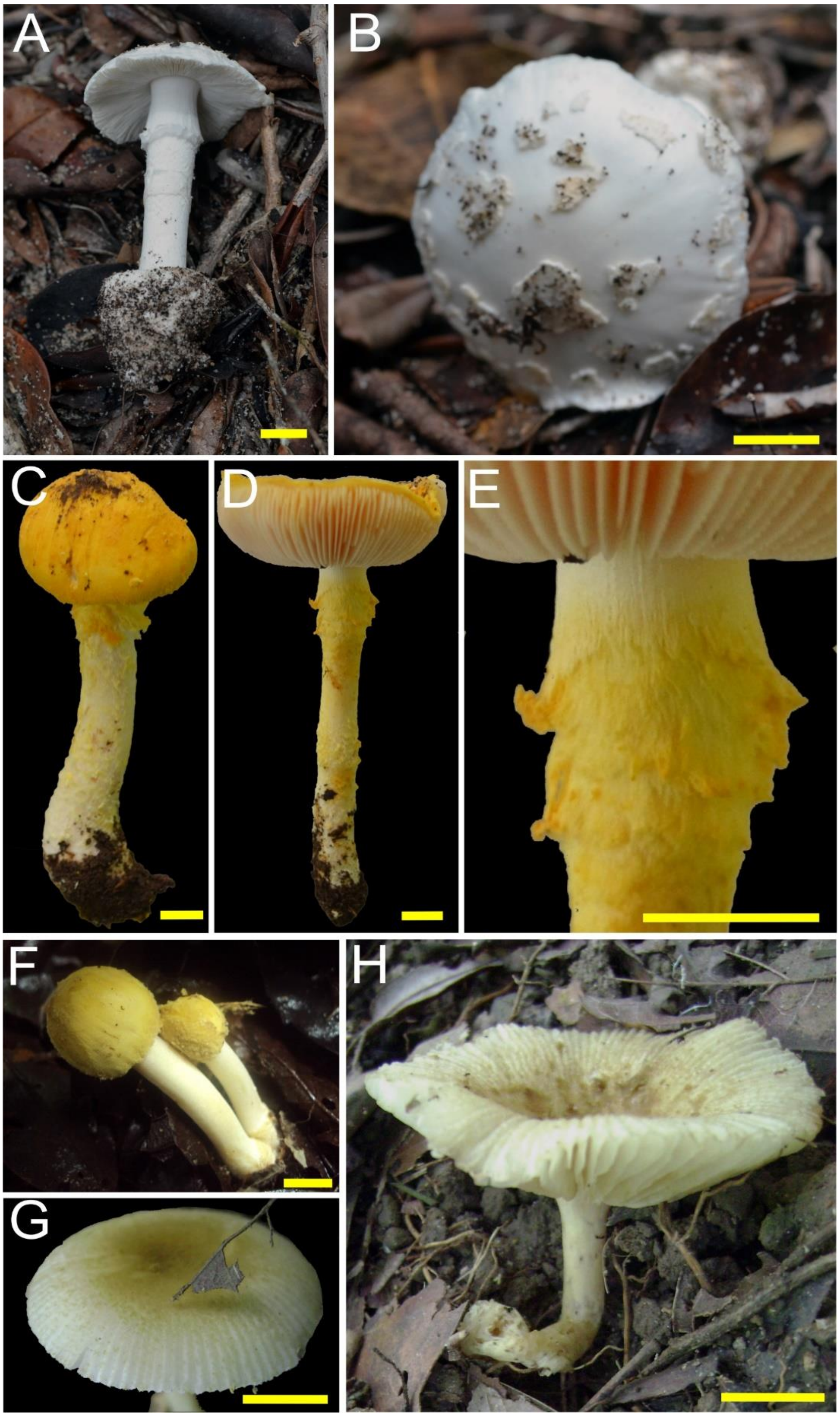
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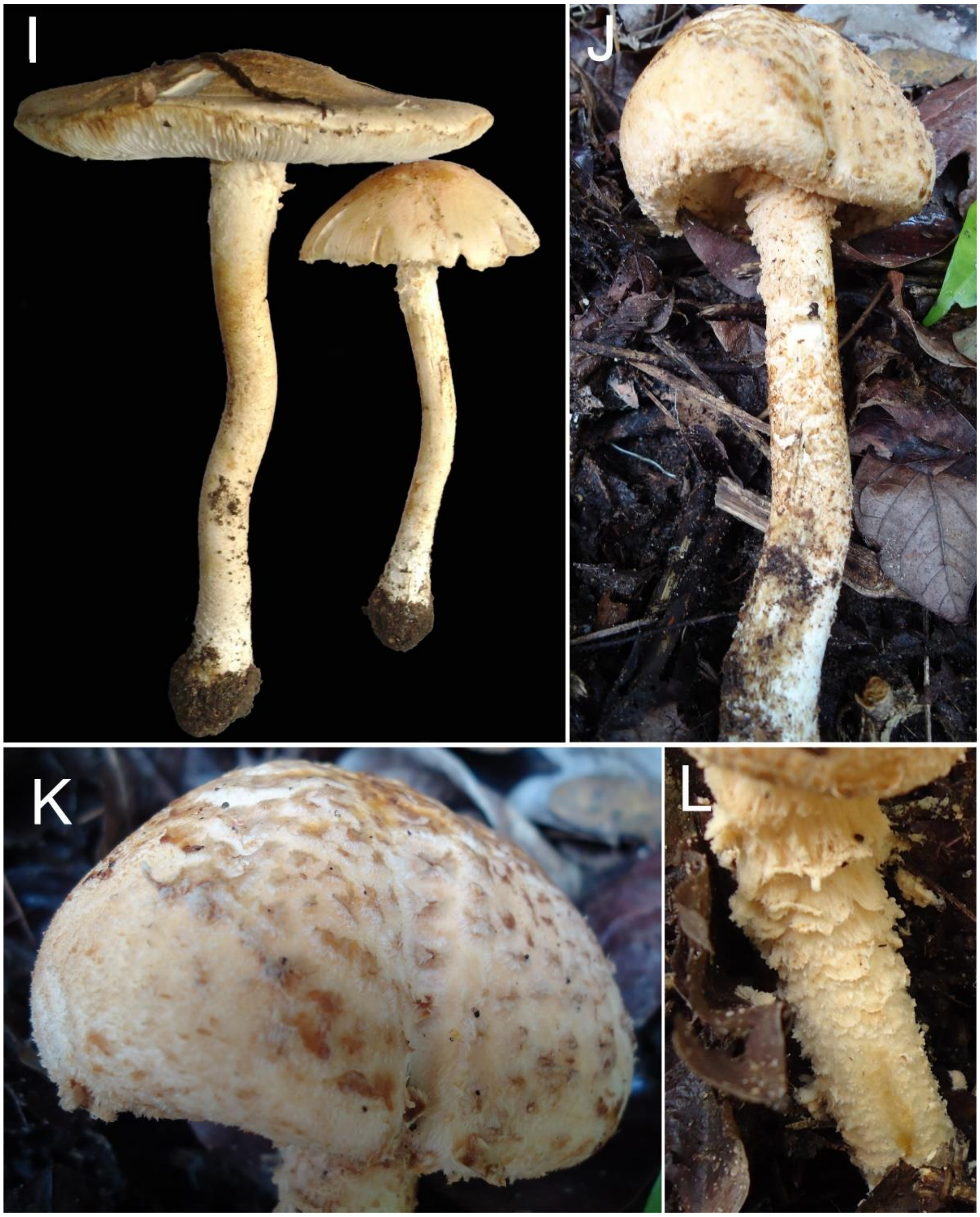
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Figure 1 – *Amanita alboturbinata*: A–B; *A. aureonauseosa*: C–E; *A. flavosulcatissima*: F–H.

Figure 2 -- *Amanita nauseosa*: I–L.

APÊNDICE F - ARTIGO 06

Four new species of *Amanita* section *Vaginatae* from Northeast Brazil

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Abstract -- Mushrooms belonging to the genus *Amanita* were collected during a fungal biodiversity study in northeast Brazil in 2014--2017. Morphological characteristics analyses were used to identify the mushrooms. Four species assignable to *Amanita* section *Vaginatae* are described as new to science and compared with phenetically similar species.

Keywords – Agaricales, Amanitaceae, morphology, neotropics, taxonomy

INTRODUCTION

Amanita Pers. has a world-wide distribution and comprises about 500 described species and likely a similar number of undescribed species, including most of the well-known mushroom-forming species of basidiomycetes (Bas 2000; Tulloss 2005, Zhang et al. 2015, Tulloss & Yang 2018). The *Amanita* systematics and phylogenetics have been treated relatively intensively in the last two decades, resulting in a much better understanding of the species diversity and relevance of morphological characters for species delimitation and identification (Weiß et al. 1998, Drehmel et al. 1999, Zhang et al. 2004, Justo et al. 2010, Cai et al. 2014, 2016, Tang et al. 2015, Tulloss et al. 2016, Thongbai et al. 2017)

The genus is divided into two subgenera [*Amanita* and *Lepidella* (E.-J Gilbert) Veselý] and seven sections [*Amanita*, *Caesareae* Singer, *Vaginatae* (Fr.) Quél., *Amidella* (E. J. Gilbert)

Konrad & Maubl., *Lepidella* (E. J. Gilbert) Corner & Bas, *Phalloideae* (Fr.) Quél., and *Validae* (Fr.) Quél.], based on both morphological and molecular evidence (Bas 1969, Yang 1997, Weiß et al. 1998, Moncalvo et al. 2000). Species in *Amanita* sect. *Vaginatae* (Fr.) Quél., are characterized by (1) the totally elongating (bulbless) stipe, (2) absence of a partial veil, and (3) usually saccate universal veil (Bas 1969, Tulloss 1992, Yang 1997, 2005, Tulloss & Yang 2018). The diagnostic microscopic features include (1) inamyloid basidiospores and (2) the rare presence of clamp connections at the bases of basidia (Bas 1969, Tulloss 1992, Yang 1997, 2005, Tulloss & Yang 2018). It has also been observed that, there are several African taxa in this section with an annulus, but without clamp connections (Tang et al. 2015).

This paper is one of a series that aims to better characterize *Amanita* species from northeast Brazil. Four new species (*A. helenae*, *A. fragilissima*, *A. adamantina*, *A. griseocrenulata***)** belonging to *Amanita* sect. *Vaginatae* are described here.

MATERIAL AND METHODS

Macromorphological descriptions were based on field notes and color photographs of basidiomata taken in the field. Colours of fresh and dry basidiomes were compared with reference colours in Kornerup and Wanscher (1978). Observations and measurements reported for micromorphological features were obtained from dried material rehydrated and mounted in distilled water, 3% KOH and Congo red or Melzer's reagent. Regarding biometric values and notation, we follow the emended methodology of Tulloss et al. (1992) and Tulloss (1993, 1994, 2000), which is summarized below.

In descriptions of marginal striations of the pileus, the abbreviation *n*R is used, where *n* is the ratio of striation length to the radius of the pileus. At the beginning of a set of spore data, the abbreviation [*a/b/c*] signifies "*a*" basidiospores measured from "*b*" basidiomata of "*c*" collections. Dimentions of basidiospores are presented in the following form *(m-) n – o (-p),* in which "*m*" is the smallest value observed or calculated and "*p*" is the largest value observed or calculated. In the range of values observed or calculated, the 5th percentile is "*n*"; and the 95th percentile is "*o*". A summary of definitions of biometric variables follows:

L, (**W**) = the range of average lengths (widths) of spores of each basidioma examined.

L’, (**W’**) = the average of all lengths (widths) of spores measured.

Q = the ratio of length to width of a spore or the range of such ratios for all spores me\asured.

Q = the average of Q computed for all basidiomata examined.

Q’ = the average of all Q values computed for all spores measured.

The type is kept at the mycological collection of JPB (Thiers, continuously updated).

TAXONOMY

Amanita helenae C.C. Nascimento & Wartchow, **sp. nov**. Fig.1

MycoBank no.: 000000

Type – BRAZIL, Paraíba, Areia, Parque Estadual Mata do Pau-Ferro, Trilha do Combe, 20 Jul. 2017, leg. *C.C. Nascimento* & *F. Wartchow* CN056 (holo-: JPB!).

Macroscopic characters -- Basidiome solitary; medium size, tall and slender. ***Pileus*** to 65--80 mm in diam., plane-concave, dark fuliginous brown (Eye brown, 7F6-8) over disc, gradually fading to light brown (6D4) to greyish brown (paler then 6D3) toward margin; *margin* sulcate-striate (0.2--03R), non-appendiculate; *context* whitish to dirty white, unchanging, to 4.5 mm thick at centre, gradually thinning then very thin (about 1 mm) at margin; *universal veil* as scattered fuliginous to almost blackish patches easily removed on handling, difficult to observe in dried state. ***Lamellae*** free, moderately crowded, whitish, with entire and concolorous edge, unchanging, up to 5 mm broad (measured at midratio); *lamellulae* scarce, attenuate. ***Stipe*** to 125--170 × 9--13 mm, equal, not bulbous; whitish at midstipe to bellow, grayish-brownish above; fibrillose near apex; *context* white, unchanging, hollow; *universal veil* as a small submembranous cup-like volva of 10 mm high, broken at apex, grayish at apex**.** ***Odor*** very weak. ***Taste*** not recorded.

Microscopic characters -- ***Basidiospores*** [80/2/2] (8.8--)9.1--13.2(--14.4) × (6.4--)6.6--9.2(--9.6) µm, (**L** = 10.2--11.5 µm; **L’** = 10.8; **W** = 7.4--7.9 µm; **W’** = 7,6; Q = (1.21--)1.24--1.66 (--1.82); **Q** = 1.39--1.45 **Q’** = 1.42), inamyloid, hyaline, colorless, smooth, thin-walled, broadly ellipsoid to ellipsoid to sometimes elongate; apiculus rounded obtuse to subattenuate, subapical; contents one or two guttules. ***Basidia*** 41.5--57 × 12--15 µm, 4- but sometimes 2-sterigmate, with each sterigmata up to 4 µm long, clampless. ***Subhymenium*** well rehydrated, up to 28 µm thick, cellular with (sub)isodiametric inflated elements 13.5--16 × 12--16 µm, 2--

3 cells deep. ***Lamellar trama*** obviously bilateral; with very common filamentous hyphae 4--8 µm and common clavate elements up to 64--80 × 21--23 µm, several of them gradually diverging from the central stratum, thin-walled; vascular hyphae occasional 14 µm wide, somewhat parallel to hymenial surface; central stratum 20--30 µm wide. ***Pileipellis*** a cutis of about 85 µm thick, somewhat gelatinized at surface (not a truly ixocutis), palely tinted by pigmentation in the upper 32 µm thick, sometimes more colorless, hyphae 2--3.2 µm wide, somewhat slightly interwoven to subradial and periclinal; the 52 µm bellow, this structure is comprised by compressed and radially oriented brownish hyphae 2.5--5 µm wide, thin walled; vascular hyphae 10--30 µm wide, very abundant, sometimes emerging from top of pileus context and transposing all pileipellis thickness. ***Pileus context*** satisfactory rehydrated; acrophysalides 64--83 × 35--40 µm, clavate to more or less elliptic, thin walled, very common; filamentous hyphae 2--10 µm, very interwoven, abundant, forming a loose matrix where other elements occur; vascular hyphae 6--10 µm wide, mostly locally common, mainly near junction between top of lamellae and context and near to pileipellis. ***Universal veil on pileus*** not observed, probably lost during drying of the basidiome. ***Universal veil on stipe base***, the *outer surface*: plentiful filamentous hyphae 2--6 µm wide, thin-walled, hyaline and colorless, somewhat parallel to surface and abundant extracellular matter; *interior* and on *inner layer*: with plentiful inflated cells 18--42 × 18--36 µm, globose, subglobose to sometimes broadly clavate e.g. 28 × 16 µm or ovoid e.g. 34 × 26 µm, sometimes the adjacent hyphae short celled; colorless to brown; thick walled to 1 µm thick; filamentous hyphae 2--6 µm, frequently also thick-walled, colorless, to pale beige, abundant; vascular hyphae absent, clamps absent. ***Stipe context*** longitudinally acrophysalidic; acrophysalides at midstipe up to 120--380 × 16--39 µm, clavate, hyaline, plentiful; filamentous hyphae 2--10 µm, with a longitudinal orientation to slightly interwoven, branched, common; vascular hyphae up to 2.5--16 µm wide, plentiful, having same orientation of other elements; at tip the acrophysalides are more shorter and the vascular hyphae are very rare to almost absent. ***Partial veil*** absent.

Other collections examined -- Brazil: Paraíba, Areia, Parque Estadual Mata do Pau-Ferro, Trilha do Engenho Triunfo, 30 Apr. 2011, leg. *F. Wartchow s.n.* (JPB).

Habit and Habitat -- Solitary on clayey soil covered by leaf-litter in Atlantic Rainforest relicts ‘Brejo de Altitude’.

Known distribution -- Presently known only from ‘Parque Estadual Mata do Pau-Ferro’, Areia (PB), northeast Brazil.

Remarks -- Among taxa of *Amanita* sect. *Vaginatae*, the striking features of *A. helenae* are the basidiospore size, universal veil of stipe base and the pileus color. The behavior of the universal veil from stipe base, suggest a close phenetic relationship with *A. castaneogrisea* Contu nom. inval., earlier considered *A. submembranaceae* var. *bispora* D.A. Reid (Tulloss 1994). As occurs with this European taxon, our new species also has submembranous volva that is gray and cracking above and persistently white at very base. However, *A. castaneogrisea* differs in the more brownish pileus color, globose to subglobose basidiospores [40/1/1] (9.8--)10.9--13.2(--15.4) × (9--)9.1--11.2 µm, (**L** =11.5 µm; **W** = 10.5 µm; Q = 1.01--1.23 (--1.34); **Q** = 1.10), and mostly thin walled inflated elements on the universal veil (Tulloss 1994).

Another taxon important to be mentioned is *A. coacta* Bas. The protologue (Bas 1978) reported 10 mm high thin felted-submembranous that broke in small gray patches on stipe base that can be compared with *A. helenae*. The Amazonian species can be primarily separated by the smaller basidiospores [10/1/1] 8.5--10 × 6.5--75. µm, Q = 1.25--1.40; **Q** = 1.30) and thin walled elements of universal veil (Bas 1978). Menolli et al. (2009) discovered this species from Atlantic Forest of the State of São Paulo, Southeast Brazil and gave more details in the behavior of the universal veil in *A. coacta*, reported that it breaks in transverse zones on stipe base. They also reported basidiospores [340/17/16] 8.7--10(--11.2) × (6.2--)7.5--8.7(--10) µm, (**L** =8.05--10.04 µm; **L’** = 9.46 µm; **W** = 6.85--8.4 µm; **W’** = 7.76 µm; Q = (1.12--)1.15--1.33(--1.40); **Q** = 1.17--1.30, **Q** = 1.22). However, the **L** and **W** values are smaller or higher than 5th percentile or 95th percentile of the basidiospores’ values presented by them. It might be a typographical error since is mathematically impossible the average value is smaller than the smallest frequent value of the basidiospore data. Yet unpublished data by Wartchow, analysis of the type and some of Menolli et al. (2009) materials report the following values: [219/7/6] (6.4--)7.2--11(--11.5) × (4.5--)5.3--8.3(--8.5) µm, (**L** =8.7--9.2 (--9.4) µm; **L’** = 9 µm; **W** = 6.4--7.1 µm; **W’** = 6.7 µm; Q = (1.14--)1.19--1.56(--1.69); **Q** = (1.28--)1.31--1.37, **Q** = 1.33). Complete type studies of Amazonian taxa and other indigenous Brazilian material deposited in several states and biomes are in preparation to be published.

Amanita calopus Beeli also shares with *A. helenaes* in the presence of small cup-like volva in the very stipe base, although this feature is not consistency (Pegler & Shah-Smith 1997, Tulloss & Yang 2018). It clearly differs more grayish pileus, in slightly more elongate basidiospores [20/1/1] 7.8--13.6(--15.1) × (5.5--)6--8.8(--9) µm, (**L** =11.7 µm; **W** = 7.7 µm; Q = (1.30--)1.39--1.65(--1.78); **Q** = 1.53), and apparent thin walled velar elements (Pegler & Shah-Smith 1997, Tulloss & Yang 2018).

Amanita colombiana Tullos, Ovrebo & Halling presents the construction of the pileipellis similar to our species, with the upper portion pale pigmented and gelatinized (Tulloss et al. 1992). However, this *Quercus* associated taxon easily differs in the fulvous becoming dark reddish to fuscous brown broken cup-like volva, subcellular subhymenium on which the basidia arise from uninflated to slightly inflated elements and globose to subglobose basidiospores [106/4/3] (9--)10--12.2(--14.2) × (8.5--)9.5--12(--14) µm, **L** = 10.8--11.5 µm; **L'** = 11.3 µm; **W** = 10.5--11.1 µm; **W'** = 10.9 µm; Q = 1.00--1.07(--1.17); **Q** = 1.03--1.04, **Q** = 1.03 (Tuloss et al. 1992).

Amanita fragilissima C.C. Nascimento & Wartchow, **sp. nov**. Fig.1

MycoBank no.: 000000

Type – BRAZIL, Paraíba, João Pessoa, *Campus* I da Universidade Federal da Paraíba (UFPB), 9 Set. 2016, leg. *C.C. Nascimento* & *F. Wartchow* CN040 (JPB).

Macroscopic characters -- Basidiome solitary; medium-sized. ***Pileus*** 55--60 mm in diam., expanded-convex, with a depressed center, pale grey-brown (5B2), darker over disc; dry; *margin* sulcate-striate (approx. 0.4R), non-appendiculate, splitting along furrows (liable to become rimose); *context* white, unchanging, 2--3 mm thick above stem, thinning evenly toward margin; *universal veil* as a large thick whitish patch over the disc. ***Lamellae*** free and remote, moderately crowded, white, up to 9 mm broad (measured at midratio), thin to moderately thick, with entire and concolorous edge, unchanging; *lamellulae* of diverse lengths, rounded truncate, unevenly distributed. ***Stipe*** 115--120 × 5--7 mm, narrowing upward, with a distinct dirty grey brown (5B2) to pale brown (4A3) appressed-fibrillose covering on a whitish background; *context* white to pale yellow (2A2), unchanging, fistulose; *universal veil* on stipe base as a membranous saccate volva, flexible, persistent, with uppermost point of limb 18 mm from stipe base, exterior white (1A1), inner surface off-white to pale grey (Code), *limbus internus* very small at point of attachment to stipe. ***Partial veil*** absent. ***Spore print*** white. ***Odor*** indistinct. ***Taste*** not performed.

Microscopic characters -- ***Basidiospores*** [70/2/2] (9.5--)9.8--15.5(--18.0) × (7.0--)8.0--13.5(--14.0) µm, [**L** =11.2--13.0 µm; **L'** = 12.1 µm; **W** = 9.6--11.2 µm; **W'** = 10.4 µm; Q = 1.04--1.35(--1.38); **Q** = 1.14--1.23, **Q** = 1.18], inamyloid, hyaline, smooth, thin-walled, globose to subglobose to broadly ellipsoid, occasionally ellipsoid; apiculus frequently rather small; contents granular to guttulate. ***Basidia*** 38--70(80--) × 13--18(--20) µm, clavate, thin-walled, 4-

spored; sterigmata to 6 µm long; basal septa clampless. ***Subhymenium*** 22--38 mm thick, of uninflated to subinflated to inflated (ovoid to clavate to irregular shaped, to 25 × 20 µm) elements; basidia arising from elements of all types. ***Lamellar trama*** bilateral, divergent; filamentous hyphae 3--16 µm wide, branching, some segments slightly inflated. ***Marginal tissue of lamellae*** sterile. ***Pileipellis*** 40--70 µm thick; partially gelatinized to extensively gelatinized at surface, filamentous hyphae 1.5--8 µm wide, branching, very tightly interwoven, without a dominant orientation, often with yellow-brown vacuolar pigments; vascular hyphae 3.5--6 µm wide, common, branching. ***Universal veil on pileus*** filamentous hyphae 1.5--10 µm wide, frequently branching, loosely interwoven near outer surface becoming more densely packed near gelatinization zone above pileipellis; inflated cells pyriform to ovoid to ellipsoid to broadly clavate, to 68 × 40 µm, terminal, single, walls 0.5--0.8 µm thick; vascular hyphae 2--9.5 µm wide common, locally plentiful in tangles. ***Universal veil on stipe base*** similar structures, but with filamentous hyphae more abundant than on pileus, sublongitudinally arranged at interior and inner surface. ***Stipe context*** longitudinally acrophysalidic; filamentous hyphae 1.8--11 µm wide, branching, dominant; acrophysalides to 168 × 38 µm, thin-walled; vascular hyphae not observed; clamps absent. **Partial veil** absent.

Other collections examined -- Brazil: Paraíba, João Pessoa, *Campus* I da Universidade Federal da Paraíba (UFPB), 9 Set. 2016, leg. *C.C. Nascimento* & *F. Wartchow* CN041 (JPB).

Habit and Habitat -- Solitary on clayey soil covered by leaf-litter in an Atlantic Rainforest fragment.

Known distribution -- Only known from the type locality, in an Atlantic Rainforest fragment located in the *Campus* I of Universidade Federal da Paraíba (UFPB).

Remarks -- The non-bulbous stipe base (resulting from the approximately centrally development of the basidiome in the primordium) and inamyloid basidiospores make *A. griseocrenulata* assignable to *Amanita* subgen. *Amanita*, sect. *Vaginatae (*Corner and Bas 1962, Bas 1969). As in many of the more gracile species of that section, the pileus margin is notably striate.

Amanita fragilíssima is well circumscribed by its rather fagile basidiome (splitting along furrows), greyish brown pileus, rather thick *universal veil* remnant in form of a large whitish patch which are mainly composed of pyriform to ovoid to ellipsoid to broadly clavate cells with walls 0.5--0.8 µm thick, membranous saccate volva and globose to broadly ellipsoid, occasionally ellipsoid basidiospores.

Amanita adamantina C.C. Nascimento & Wartchow, **sp. nov.** Fig.1

MycoBank no.: 000000

Type – BRAZIL, Bahia, Chapada da Diamantina, Abaíra, Catolés de Cima, Serra do Barbado, Mata do Tijuquinho 9 Jan. 2015, leg. *F. Wartchow* et al. FW 05/2015 (JPB).

Macroscopic characters — Basidiome solitary; small to medium-sized. ***Pileus*** 35--70 mm wide, at first obtusely conic, becoming convex to plano-convex; surface dry, subshiny, dark greyish brown (6F3) to grey-brown (6E3) when young, light brown (Camel, 6D4) to brown (6E4) at maturity, always paler over small umbo and striations; *margin* sulcate-striate (approx. 0.5R), non-appendiculate; *context* white to whitish, unchanging, 2--4 mm thick above stem, rather thin above lamellae; *universal veil* absent from pileus surface. ***Lamellae*** very narrowly adnate with a decurrent line up to 5 mm on the top of the stem**,** close to moderately close, white, unchanging, up to 4 mm broad (measured at midratio); edge minutely serrate to denticulate, concolorous; *lamellulae* common, subtruncate to subattenuate, of diverse lengths, unevenly distributed. ***Stipe*** 55--110 × 5--9 mm, cylindric to narrowing slightly upward, flaring slightly at the very top, subsmooth, white (1A1) to dirty white; *context* white (1A1), unchanging, fistulose; *universal veil* on stipe base as soft, thin membranous saccate volva, white (1A1) on inner and outer surfaces, 15--18 mm from stipe base to highest point of limb, attached to stipe for 5--8 mm. **Partial veil** absent. **Spore print** white. **Odor** indistinct. **Taste** not performed.

Microscopic characters — **Basidiospores** [90/3/1] (8.5--)8.7--10.2(--10.7) × (7.2--)7.6--9.7 µm, (**L** = 9.2.0--9.8 µm; **L’** = 9.5; **W** = 8--8.8 µm; **W’** = 8,4; Q = 1.05--1.18; **Q** = 1.12--1.15 **Q’** = 1.13), inamyloid, hyaline, smooth, thin-walled, globose to broadly ellipsoid; apiculus sublateral, rather broad, truncate; contents guttulate. ***Basidia*** 30--46 × 10--16 µm clavate, thin-walled, 4-spored; sterigmata to 4 µm long; basal septa clamped. ***Subhymenium*** a sparsely branching structure composed mostly of short uninflated hyphal segments (some nearly parallel to central stratum), with occasional clavate to ovoid to narrowly ellipsoid to irregularly shaped cells, to 18 × 12 µm; clamps common. ***Lamellar trama*** bilateral divergent, but somewhat obscurely so in some regions, central stratum 36--45 µm wide; filamentous hyphae 2--8.5 µm, frequently branching, closely pecked, dominating, occasionally with slightly inflated intercalary elements; inflated cells difficult to distinguish (broadly ellipsoid to subglobose, to 32 × 28 µm); vascular hyphae not observed. ***Marginal tissue of lamellae*** sterile, forming a broad strip of subclavate to broadly clavate or ellipsoid cells, sometimes pedunculate, colourless, thin-walled, 18--40 × 14--36 µm. ***Pileipellis*** 48--80 µm thick, colorless except for the brownish yellow gelatinized surface; filamentous hyphae 1.5--7.5 µm wide, dominantly subradially oriented, densely interwoven, extensively gelatinizing at the surface; vascular hyphae 2.5--8.2 µm wide, sinuous, infrequent. ***Universal veil on stipe base***, the *outer surface*: a thin layer composed of slightly gelatinizing filamentous hyphae 2.2--7.0 µm wide, branching, sublongitudinally oriented; vascular hyphae not observed; *interior*: composed of longitudinally to irregularly arranged elements; filamentous hyphae dominant, 1.5--8 µm wide, thin-walled, branching, anastomosing; inflated cells terminal, thin-walled, colorless to sordid yellow, globose to subglobose to pyriform to broadly ellipsoid, to 70 × 63 µm, infrequently long ellipsoid to subfusiform, to 78 × 30 µm; vascular hyphae 2.0--11 µm wide, locally common, clamps present; *inner surface*: filamentous hyphae 1.5--6 µm wide, partially gelatinized, densely interwoven, sublongitudinally oriented; vascular hyphae not observed. ***Stipe context*** longitudinally acrophysalidic; filamentous hyphae 1.3--9.5 µm wide, branching; acrophysalides to 160 × 30 µm, thin-walled; vascular hyphae not observed; clamps present.

Habit and Habitat -- Solitary on clay soil in a 'misty forest' (sensu Zappi et al. 2003) about 1700 m alt. According to these authors, *Guapira obtusata* (Jacq.) Little (1000--1850 m alt.) and *Coccoloba brasiliensis* Nees & Mart. (1000--1700 m alt.) are putative ECM trees reported as found in similar altitude to our new species.

Known distribution -- Only known from the type locality, in the Chapada da Diamantina, Bahia, Brazil.

Remarks – In sect. *Vaginatae*, *A. adamantina* is closest morphologically to *A. crebresulcata*, originally described from Brazil. Both especies share some similarities, namely the grey-brown pileus surface with absence of universal veil remnants and the very thin membranous volva at stipe base. However, *A. crebresulcata* diferrs from *A. adamantina* by its coloured stipe, small ellipsoid basidiospores and clampless basidia. Furthermore, *A. crebresulcata* exibits a distinctly broader and more densely sulcate pileus margin (Bas 1978).

Amanita griseocrenulata C.C. Nascimento & Wartchow, **sp. nov.** Fig.1

MycoBank no.: 000000

Type – BRAZIL, Rio Grande do Norte, Natal, Parque Estadual das Dunas do Natal (PEDN), Trilha Peroba, 08 Jun. 2017, leg. A.G. Santos AGS853 (JPB).

Macroscopic characters — Basidiome solitary; small to medium-sized. ***Pileus*** 48--65 mm wide, planar or plano-concave at matutity; surface dry, matte, chocolate brown (6F4) to teak brown (6F5) in the center, gradually fading to café-au-lait (6D3) to brownish beige (6E3) towards the margin; *margin* not appendiculate, sulcate-striate (0.4--0.6R); context whitish, unchanging, thin, about 2 mm thick over stipe, and rapidly thinning toward the margin; *universal veil* as crumb-like warts which separate easily from the cap, off-white to yellowish grey (4B2) to greyish orange (5B3). **Lamellae** free, slightly convex, close, pale gray (1B1), unchanging, up to 5 mm broad (measured at midratio); edge slightly crenate and minutely powdered, concolorous; lamellulae always truncate, occurring at the rate of 0--1 between each adjacent pare of regular gills. ***Stipe*** 75--90 × 0.4--0.5 mm, narrowing upward, white (1A1) to yellowish white (1A2), with a powdery to chalky surface above, slightly fibrillose below; *context* stuffed, white (1A1), unchanging; *universal veil* on stipe base as a saccate volva, white (1A1) to yellowish white (1A2), brittle and easily broken into large patches, 13--16 mm from the small cuplike part of the volva that may appear to be a basal bulb. **Partial veil** absent. **Spore print** white. **Odor** indistinct. **Taste** not performed.

Microscopic characters — **Basidiospores** [60/1/1] (7.4--)8.8--12.0(--13.5) × (6.5--)7.8--11 (12.4) µm, (**L** = 9.4 µm; **W** = 8.8 µm; Q = (1.0--)1.03--1.14 (--1.20); **Q** =1.08), inamyloid, hyaline, smooth, thin-walled, globose to subglobose, rarely broadly ellipsoid; contents guttulate. ***Basidia*** 25--60 × 9--14 µm clavate, dominantly 4-, occasionally 2-spored, thin-walled; clampless. ***Subhymenium*** comprising occasionally branching structure of short hyphal segments, uninflated or barely inflated, roughly perpendicularly oriented to central stratum, with hyphae parallel to central stratum sometimes passing within 5--12 µm µm of base of a basidia. ***Lamellar trama*** bilateral divergent, with subhymenial elements diverging shallowly or at angles up to 90º; central stratum to 40 µm thick; filamentous hyphae 1.5--7.5 µm wide, branching, apparently lacking inflated cells; vascular hyphae scarce to locally common, 2.5--8 µm wide. ***Marginal tissue of lamellae*** sterile, with inflated cells pyriform or clavate (28--60 × 14--45 µm), colourless, abundant to relatively abundant, disarticulating. ***Pileipellis*** non-gelatinized on top, 30--50 µm thick, very pale brownish yellow; filamentous hyphae 1.2--12 µm wide, branching, rather tightly interwoven, without dominant orientation; vascular hyphae 3--7.5 µm wide, branching, smoothly curving. ***Universal veil on pileus***: filamentous hyphae 1.5--8 µm wide, branching, interwoven among inflated cells, abundant; inflated cells terminal, singly, relatively abundant, thin-walled, broadly ellipsoid to ovoid to subglobose (to 72 × 50 µm), clavate (to 120 × 40 µm); vascular hyphae 2.5--6 µm wide, occasional; elements irregularly arranged. ***Universal veil on stipe base***, the *outer surface*: a very thin layer comprising narrow groups of fascicles of hyphae, moderately gelatinized, co-parallel, with abundant inflated cells of interior easily visible between groups; filamentous hyphae 2.5--6 µm wide, abundant, branching; vascular hyphae not observed; *interior*: filamentous hyphae 2.5--7.5 µm wide, abundant, branching, in loosely interweaving fascicles, many segments with somewhat thickened walls (to 0.5 µm thick); inflated cells dominating, globose to subglobose to subpyriform to broadly ellipsoid (to 80 × 70 µm), terminal, singly or in short chains, with wall thin or to 1.0 µm thick; vascular hyphae 3.5--5 µm wide, uncommon; *inner surface*: moderately gelatinized, hyphae dominant, rather densely packed; inflated cells fewer, smaller, and relatively narrower then interior.

Stipe context longitudinally acrophysalidic; filamentous hyphae, 1.5--12 µm wide, abundant, branching; acrophysalides to 180 × 38 µm, thin-walled; vascular hyphae 1.2--8.5 µm wide, especially frequent near stipe surface.

Habit and Habitat -- Solitary in sandy soil of native tropical forest on coastal dune (Atlantic rainforest biome).

Known distribution -- Only known from the type locality, in the ‘Parque Estadual das Dunas do Natal/Trilha Peroba’, Natal, Brazil.

Remarks -- *A. griseocrenulata* is a member of *Amanita* subgen. *Amanita*, sect. *Vaginatae.*Remarkable features of *A. griseocrenulata* are the dark brown pileus at centre, the pale gray lamellae with a slightly crenate and minutely powdered edge, the rather incoherent universal veil tissue and the globose to subglobose basidiospores. The most morphologically similar species are *A. coacta* Bas and *A. craseoderma* Bas, originally described from Brazil. Both species share some features with *A. griseocrenulata*, such as a fiable universal veil remnnts on pileus in form of small patches or warts and clampless basidia. However, *A. coacta* differs from *A. griseocrenulata* in hav*ing* white lamellae and shorter basidiospores with a higher Q value [10/1/1] 8.5–10.0 × 6.5–7.5 µm, (Q = 1.25–1.40; Q = 1.30; Q' = 1.30) (Bas 1978); [340/17/16] 8.7–10(–11.2) × (6.2–)7.5–8.7(–10) µm, Q = 1.17–1.3; Q’ = 1.22 (Menolli et al. 2009). While *A. craseoderma* is distinguishable from *A. griseocrenulata* based on its much more friable volva (forming grey belts on stipe base), presence of up to 25 µm wide pigmented hyphae in the pileipellis and shorter basidiospores [10/1/1] 7.5–9 × 7–8 µm (Bas 1978).

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A
B
C
D
E
F
G
H
I
J

Figure 1 -- *Amanita helenae*: A--D, mature basidiomata; *A. fragilíssima*: E--G, mature basidiomata; *A. griseocrenulata*: H--J, mature basidiomata.

APÊNDICE G - ARTIGO 07[1]

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[1] Artigo a ser submetido para publicação na revista ‘Mycotaxon’.

Checklist of *Amanita* for South America, especially annotated with regard to Brazilian and Guyana species

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Abstract – We present an annotated bibliographic survey of species of *Amanita* that occur in South America. In the region of study, this genus is represented by 57 known (and possibly distinct) taxa. Discounting possible or probable synonyms, probably misapplied names, and exotic species a more conservative count is 47 taxa; of these, 14 or 15 are known from Brazil or Guyana. The count of confirmed exotic taxa is 6. Four taxa are classed as insufficiently known. Seven taxa are excluded for lack of evidence that they really occur in the region of study.

Keywords – Agaricomycetidae, Amanitaceae, neotropics, taxonomy

INTRODUCTION

Amanita Pers. is one of the most well-known fungal genera in terms of both morphotaxonomy and molecular phylogenetics (Weiß et al. 1998, Drehmel et al. 1999, Yang et al. 2004, Tulloss 2005, Letcher 2007, Cai et al. 2014, 2016), accounting for more than 500 described and accepted species that are distributed worldwide, except Antarctica (Yang 2005, Tulloss 2005, Kirk et al. 2008). It primarily comprises those species of the family Amanitaceae that has the basidiome produced by schizohymenial ontogeny, in which all structural elements develop within a solid primordium and are separated by development of gelatinizing or friable intermediary tissues allowing edges of lamellae to separate from a partial veil or stipe surface, and hymenial surfaces of lamellae to be segregated from each other (Bas 1969, Yang & Oberwinkler 1999, Tullos et al. 2016). Alternatively, *Amanita* species can be recognized by the following combination of characters: (1) stipe tissue longitudinally acrophysalidic, (2) lamellar trama bilateral-divergent, (3) sterile edges of lamellae and (4) absence of gluten and gluten-retaining hyphae on pileus (Tullos et al. 2016, Tulloss & Yang 2017). Moreover, species in this genus are of outstanding ecological significance due to their mycorrhizal relationship with vascular plants (Yang et al. 1999, Yang 2005, Wolfe et al. 2002b).

Studies on *Amanita* from South America were initiated along with the launch of studies on neotropical fungi. The earliest records of *Amanita* species from South America date back to Rick (1906, 1937, 1938), Singer & Digilio (1952) and Singer (1953, 1954). Later works were published by Homrich (1965), Bas (1969, 1978), Schalkwijk & Jansen (1982), Pegler (1983), Pulido (1983), Grandi et al. (1984), Capelari & Maziero (1988), Garrido & Bresinsky (1985), Raithelhuber (1986, 1991) and Garrido (1988).

Over the last two decades, the information on the systematics and diversity of Amanitas from South America, especially related to the Brazilian and Guyana species, are roughly divided into scarce monographs, such as Tulloss et al. (1992) from Andean Colombia, and some scattered published advances. In this case, the updated information is available from a variety of sources, such as articles in several scientific journals (Bas & de Meijer 1993, Stijve & de Meijer 1993, Tulloss & Halling 1997, Giachini et al. 2000, de Meijer 2001, Simmons et al. 2002, Sobestiansky 2005, Wartchow & Maia 2007, Wartchow et al. 2007, 2009, 2013a, 2013b, 2015a, 2015b, Lechner & Albertó 2008, Menolli et al. 2009a, 2009b, Wartchow 2015, 2016) and books (local and regional floras, Pegler 1997, de Meijer 2006), besides unpublished theses and dissertations.

The aim of the present study is present a checklist of all amanitas that occur in South America, emphasizing their distribution and potential host trees, as well presentation of basidiospores data.

MATERIAL AND METHODS

For elaboration of the check list, several works consulted are referred in the text. Generic and infrageneric concepts follow Corner & Bas (1962), Bas (1969) and Bas (1978), as modified by Yang (1997, 2005).

Herbaria acronym follow Thiers [continuously updated], with the following exceptions: HKAS –Herbarium of Institute of Botany (Academia Sinica, Kunming, Yunnan Province, China); RET – Personal Herbarium of Tulloss; TLXM – Herbarium of the University of de Tlaxcala, Tlaxcala, México. Abbreviation of fungal authors name follow Kirk & Ansell (1992) with the exception of 'E.-J. Gilbert', on which will be used only the family name, due it appears in the most of citations.

In the list, we used the following annotations as summarizing by Tulloss & Lindgren (2005). At the beginning of a set of spore data, the notation "[*a*/*b*/*c*]," where *a, b,* and *c,* are integers, is to be read "*a* spores were measured from *b* basidiomata taken from *c* collections." When ranges are provided in spore data in the form "(*m*-) *n*–*o* (-*p*)," where *m, n, o,* and *p* are integers, the values given are to be understood as follows: *m* is the smallest value observed or calculated and *p* is the largest value observed or calculated. In the range of values observed or calculated, the 5th percentile is *n*; and the 95th percentile is *o*.

In the basidiospores' descriptions, we present the following biometric variables:

L, (**W**) = the range of average lengths (widths) of spores of each basidioma examined.

L', (**W'**) = the average of all lengths (widths) of spores measured.

Q = the ratio of length to width of a spore or the range of such ratios for all spores measured.

Q = the average of Q computed for all basidiomata examined.

Q' = the average of all Q values computed for all spores measured.

Ecological data were selected after bibliographic revision and included in each taxon. The materials reviewed for basidiospores data are followed by the herbarium acronym where each one is deposited.

In the list, where appears the annotation '(1)' probably correspond to taxonomic synonyms, '(2)' are considered *nomina dubia* by specialists in the genus, or '(3)'correspond misidentification and are also marked with the symbol "†". The conservator account of each taxon is near to that symbol. Each taxon that appears in the list is accompanying by the basidiospores data and their bibliographic reference. In the annotation of each taxon, 'N' means "notes" and 'S' "spores" (i.e., basidiospores).

RESULTS

1 – List of taxa of *Amanita* that occur in South America.

I. Subgenus *Amanita*

A. **Section *Amanita*** – 20 taxa listed, with conservator account 15, with 9 taxa from Brazil and Guyana.

1. *A*. alinea Wartchow & Cortez – **Brazil**: Rio Grande do Sul (Wartchow & Cortez 2016). **N**: This species is known in Brazil from a single specimen found on soil, under *Eucalyptus* sp. plantation, in the biome Pampa. **S**: (Wartchow & Cortez 2016) from holotype (ICN) – [60/1/1] (7.5–) 8.5–14.5 (–16) × (5.7–) 6–9.5 (–11) µm, [**L** = 10.8 µm; **W** = 7.2 µm; Q = (1.14–) 1.28–1.71 (–1.82); **Qm** = 1.50].
2. <u>*A. aurantiovelata* Schalkw. & G.M Jansen</u> – **Chile** (Schalkwijk & Jansen 1982, Garrido & Bresinsky 1985, Raithelhuber 1986). **N**: This entity occurs under *Nothofagus dombeyi* (Mirb.)Oerst. and *N. obliqua* (Mirb.) Oerst., as well other species of *Nothofagus* Blume (Valenzuela et al. 1999). The type locality of the species is in the state of Kansas, EUA. The holotype is deposited at L. Garrido believes that taxon might be synonym of *A. gayana*. However, the original illustration showed this latter species with sac-like volva and non-striate pileal margin. We suggest the readers that review the comparison made by Simmons et al. (2002) between *A. gayana* and *A. aurantiobrunnea* in section *Phalloideae* (bellow). **S**: (Tulloss & Horak unpubl. data) from Chilean material (ZT) – [61/3/3] (8.8–) 9.0–12.0 (–12.6) × (6.0–) 6.4–7.6 (–9.0) µm, [**L** = 9.6–11.0 µm; **L’** = 10.2 µm; **W** = 6.8–7.4 µm; **W’** = 7.0 µm; Q = (1.28–) 1.34–1.61 (–1.69); **Q** = 1.40–1.50; **Q’** = 1.46].
3. <u>*A. calochroa* C. Simmons, T.W. Henkel & Bas</u> – **Guyana** (Simmons et al. 2002). **N**: Simmons et al. (2002) describe the habitat of this species as follows: “in litter mats accumulated in crooks of the trunks of *Dicymbe corymbosa* Spruce ex Benth. (Caesalpinaceae) in riverine adjacent slope forest dominated by *D. corymbosa* and *D. altsonii* Sandwith., with *Micrandra glabra* (R.E. Schult.) R.E. Schult. (Euphorbiaceae), *Moronobea* sp. (Guttiferae) and other mixed hardwoods. Growing on sandy soil with thick organic matter accumulations on grey sands and exposed sandstone boulders and cliff faces”. **S**: (Simmons et al. 2002) from holotype and paratype (BRG, L) – [25/2/2] 6.3–7.8 (–8.4) × 5.5–7.8 µm, [Q = 1.0–1.2 (–1.4); **Q** =

1.06–1.19].

4. *A. chrysoleuca* Pegler – **Brazil**: Paraná (de Meijer 2006). **Martinique** (Pegler 1983). **N**: Pegler (1983) reported that species was collected in soil from a semi-decidual Forest about 2000 m alt and transitional xero-mesophitic about 200 m in Martinica; de Meijer (2006) colleted in dense ombrofilous forest. We have not opportynity to review this material. **S**: (Pegler 1983) from holotype – 7–9.5 × 4.5–6 mm (**L'** = 8 µm, **W'** = 5 µm, **Q** = 1.56).

5. *A. diemii* Singer – **Argentina** (Singer 1954, 1969, Raithelhuber 1986, 1991). **Chile** (Garrido1988). **N**: It includes *A. umbrinella sensu* Singer pro parte (Tulloss & Horak t.b.p.). Garrido (1988) lists these mycorrhizal associates of the present species: *N. alpina* (Poepp. ex A. DC.) Oerst., *N. antarctica* (G. Forst.) Oerst., *N. dombeyi*, *N. glauca* (Phil.) Krasser and *N. obliqua*. **S**: (Tulloss & Horak unpubl. data) from holotype and other materials from Argentina and Chile (BAFC) – [94/5/3] (9.0–) 9.5–11.5 (–12.8) × (7.5–) 8.2–10.2 (–11.5) µm, (**L** = 10.0 –10.7 µm; **L'** = 10.4 µm; **W** = 9.0–9.8 µm; **W'** = 9.3 µm; Q = (1.02–) 1.06–1.22 (–1.28); **Q** = 1.10–1.15; **Q'** = 1.12).

6†. *A grauiana* Garrido – **Chile** (Garrido 1988). **N**: Probably a synonym of *A. ushuaiensis* (Tulloss & Horak unpubl. data). Garrido (1988) reports the present species growing with *Nothofagus glauca* and *N. obliqua* in forest mixed with *Chusquea* Kunth. **S**: (Tulloss & Horak unpubl. data) from isotype and one paratype (ZT) – [40/2/2] (9.0–) 10.8 –16.5 (–17.0) × (7.9–) 8.0–10.3 (–14.0) µm, [**L** = 12.8–13.2 µm; **L'** = 13.0 µm; **W** = 8.8–8.9 µm; **W'** = 8.9 µm; Q = (1.23–) 1.30–1.62 (–1.65); **Q** = 1.43–1.50; **Q'** = 1.46].

7. *A. lanivolva* Bas – **Brazil**: Amazonas (Bas 1978). **Guyana** (Simmons et al. 2002). **N**: In the protologue, Bas (1978) states "common .in secondary tropical rain forest, near *Neea* Ruiz & Pav. (Nyctaginaceae) [ectomycorrhizal connection established by collector] with nearby Rubiaceae, Sapindaceae, Euphorbiaceae, Leguminosae, Flacourtiaceae, and Palmae". Simmons et al. (2002) describe the habitat in Guiana as follows: "Riverine swamp forest dominated by *Dicymbe altsonii* and *D. corymbosa* with scattered associated hardwoods". It probably is one the few known species of the section *Amanita* with bulb covered by a membranous saccate volva. (See also *A. pseudospreta* in sect. *Vaginatae*, bellow). **S**: (Simmons et al. 2002) from Guyanese collections (BRG, L) – [40/3/3] 7.4–9.8 × 5.0–6.6 (–7.2) µm, (Q = 1.3–1.65; **Q** = 1.4–1.55). (Bas 1978) from holotype, isotype and paratype (INPA, L) – [20/2/2] 7–9.5 x

5.5–7 um, [Q = (1.2–) 1.25–1.6 (–1.65); **Q** = 1.3–1.5]. Tulloss (unpubl. data) from a duplicate in L – [30/1/1] (7.9–) 8.0–9.1 (–10.5) × (5.4–) 5.5–6.6 (–6.9) µm, [**L’** = 8.6 µm; **W’** = 6.0 µm; Q = (1.31–)1.32–1.55 (–1.67); **Q** = 1.43].

8†. *A. merxmuelleri* Bresinsky & Garrido – **Chile** (Garrido & Bresinsky 1985). **N**: In the protologue, the species was described as growing under *Nothofagus pumilio* (Poepp. & Endl.) Krasser. Probably synonym of *A. ushuaiensis* (Tulloss & Horak, unpubl. data). **S**: (Tulloss unpubl. data) from isotype (ZT) – [18/1/1] (10.1–) 10.6–14.0 (–15.0) × (6.5–) 6.8–9.0 (–10.1) µm, [**L** = 12.5 µm; **W** = 8.0 µm; Q = (1.25–) 1.34–1.80 (–2.11); **Q** = 1.58].

9. *A. morenoi* Raithelh. – **Argentina** (Raithelhuber 1986, 1991, Tulloss & Halling 1997). **N**: This species was originally described as occurring in ectotrophic forest (probably including *Nothofagus*). **S**: (Tulloss & Halling 1997, Tulloss & Horak unpubl. data) from holotype and other materials (BAFC) – [70/2/2] (8.4–) 8.8–12.2 (–19.6) × (7.0–) 7.5–10.5 (–15.4) µm, [**L** = 10.3–10.5 µm; **L’** = 10.4 µm; **W** = 8.4–9.2 µm; **W’** = 8.8 µm; Q = (1.00–) 1.07–1.31 (–1.33); **Q** = 1.14–1.21; **Q’** = 1.18].

10. *A. muscaria* (L.: Fr.) Lam. subsp. *muscaria* – **Argentina** (Raithelhuber 1986). **Brazil** (Homrich 1965). **Chile** (Garrido & Bresinsky 1985; Garrido 1988). **Uruguay** (Garrido & Bresinsky 1985). **N**: (1) Garrido & Bresinsky (1985) listed the following forms from Uruguay, but probably, represent different stages of maturation, intensity of exposition to Sun light, imperfect distribution, partial development of pigment etc.: *A. muscaria* f. *aureola* (Kalchbr.) J.E. Lange, *A. muscaria* f. *formosa* (Pers.) Gonn. & Rabenh., *A. muscaria* f. *puella* Gonn. & Rabenh. e *A. muscaria* f. *sanguinea* Gonn. (2) Any case of material correctly identified in Brazil as *A. muscaria* no Brasil, certainly was intodued with exotic trees (e.g.., Pinaceae); revision of the exsiccate for determinate the infrageneric status of each collection *A. muscaria* in Brazil is required. **S**: (Tulloss & Geml unpubl. data) for several materials of the belonging to the taxon (ALA, BAFC, H, HKAS, L, NMLU, O, P, RET) – [475/24/19] (7.4–) 8.5–11.5 (–13.1) × (5.6–) 6.5–8.5 (–9.8) µm, [**L** = (8.7–) 9.1–11.2 (–11.4) µm; **L’** = 10.0 µm; **W** = (6.5–) 6.9–8.1 (–8.2) µm; **W’** = 7.5 µm; Q = (1.10–) 1.21–1.47 (–1.75) µm; **Q** = 1.26–1.41 (–1.42) µm; **Q’** = 1.34].

11. *A. muscaria* subsp. *flavivolvata* Singer – **Argentina** (Raithelhuber 1986). **Brazil** (Giachini et al. 2000; Sobestiansky 2005; Wartchow et al. 2013a). **Colombia** (Pulido 1983, Tulloss et al. 1992). **Costa Rica** (Tulloss et al. 2011, Tulloss & Geml unpubl.

data). **Mexico** (Tulloss & Geml unpubl. data). **USA** (Tulloss 2005, Tulloss & Geml unpubl. data). **N**: This subspecies was originally described from San Francisco, California, EUA. Tulloss (unpubl. data) notes that subsp. *flavivolvata* has one center of distribution in western N. America and another in southeastern N. America. It also occurs naturally with *Quercus* and members of the Pinaceae from Mexico south at least to near the Panamanian border in Costa Rica. It has been introduced with foreign trees in Argentina. The material from Colombia (FH) was found in a *Pinus* plantation and also introduced to this country. **S**: (Tulloss unpubl. data) for several specimens (BAFC, F, FH, MAINE, NY, O, RET, SFSU, TLXM, USJ, XAL) – [957/48/37] (7.5–) 9.0–12.8 (–19.0) × (5.5–) 6.5–8.5 (–11.5) µm,[**L** = (8.9–) 9.4 –12.1 (–14.6) µm; **L'** = 10.7 µm; **W** = (6.6–) 6.9–8.2 (–8.4) µm; **W'** = 7.6 µm; Q = (1.11–) 1.26–1.67 (–2.23); **Q** = (1.29–) 1.31–1.65 (–1.95); **Q'** = 1,42].

12†. *A. muscaria* var. *alba* Peck – **Uruguay** (Garrido & Bresinsky 1985). **N**: The taxon itself is not well understood within its native range (southern Canada and northern states of USA). Many of the characters provided for var. *alba* by Jenkins (1977, 1986) are also characteristics of aging, bleached specimens of the more common *A. muscaria* var. *guessowii* Veselý [Jenkins 1977 as "*A. muscaria* var. *formosa*" (sic) 1986; Tulloss 2007a].

13†. *A. pantherina* (DC.: Fr.) Krombh. – **Brazil**: Santa Catarina (Giachini et al. 2000). **Argentina** (Lechner & Albertó 2008). **Uruguay** (Garrido & Bresinsky, 1985). **N**: The probably presence of this European species in South America is given only with introduction of exotic trees. Revision of material named "*A. pantherina*" is necessary. **S**: (Tulloss unpubl. data) from materials from Europe (IB, L, NMLU, O, RET) – [260/13/6] (7.5–) 9.0–12.0 (–14.0) × (5.2–) 6.2–8.2 (–9.8) µm, [**L** = 9.6–11.2 (–11.3) µm; **L'** = 10.3 µm; **W** = 6.7–7.7 (–8.0) µm; **W'** = 7.2 µm; Q = (1.20–) 1.28–1.62 (–1.77); **Q** = 1.32–1.51 (–1.61); **Q'** = 1.42].

14. *A. petalinivolva* Wartchow – **Brazil**: Rio Grande do Sul (Wartchow et al. 2013b). **N**: This species was collected in 'restinga' vegetation. **S**: (Wartchow *et al*. 2013b) from holotype (ICN) – [90/3/3] (7.3–)7.7–11(–14.5) × (5–)5.5–7 (–7.5) µm, [**L** = 9.3–9.7 µm, **L'** = 9.5 µm; **W** = 6.1–6.4 µm, **W'** = 6.2 µm; Q = (1.28–)1.30–1.87(–2.00); **Q** = 1.52–1.57; **Q'** = 1.55].

15. *A. sulcatissima* Bas – **Brazil**: Amazonas (Bas 1978, Singer & Araújo 1979). **N**: In the protologue, Bas (1978) states "in Campina vegetation under trees (Humiriaceae,

Burseraceae, Ochnaceae, Sapindaceae, Leguminosae and Sapotaceae)". **S**: (Bas 1978) (INPA, L) – [10/1/1] 8–9 × 6–7 (–7.5) µm, (Q = 1.2–1.4; **Q** = 1.3).

16. *A. toxica* Lazo *nom. inval.* – **Chile** (Lazo 1982, Garrido & Bresinsky 1985). **N**: This is the Chilean species called *A. gemmata* in some of Garrido's publications. Lazo (1982) originally described the taxon as a variety of *A. gemmata* and reported that it was toxic. The species occurs in endemic *Nothofagus* forest with plantation of *Pinus* (e.g., *P. radiata* D. Don). The name has never been validated. Well-documented and well-preserved material suitable for a type collection is needed. **S**: (Tulloss & Horak unpubl. data) from Chilean materials (ZT) – [60/2/1] (8,0–) 8,5–11,6 (–13,5) × (6,6–) 7,0–9,5 (–10,0) µm, [**L** = 9,4–10,1 µm; **L'** = 9,7 µm; W = 7,7–8,4 µm; **W'** = 8,0 µm; Q = (1,09–) 1,12–1,32 (–1,69); **Q** = 1,21; **Q'** = 1,21].

17[†]. *A. umbrinolutea* (Secr. *ex* Gillet) Bataille *sensu* Raithelh. – **Argentina** (Raithelhuber 1986). **N**: Probably a synonym of *A. ushuaiensis* (Tulloss & Horak t.b.p.), and therefore occurring with *Nothofagus*. **S**: (Tulloss & Horak unpubl. data) very few obtained from badly preserved material from Tierra del Fuego (BAFC) – [4/1/1] 11.8–14.0 × 8.0–10.5 µm.

18. *A. ushuaiensis* (Raithelh.) Raithelh. – **Argentina** (Raithelhuber 1986, 1991). **N**: A species occurring throughout the range of *Nothofagus* in the southern cone of the continent onto the island of Tierra del Fuego (Tulloss & Horak unpubl. data). **S**: (Tulloss & Horak unpubl. data) (ZT) – The cotype (isotype) (ZT) of that species is immature and lack spores. Tulloss and Horak still looking for the holotype.

19. *Amanita viscidolutea* Menolli, Capelari & Baseia – **Brazil**: Rio Grande do Norte (Menolli et al. 2009) and Paraíba (Wartchow et al. 2013b). N: the type study and analysis of additional material by was performed by Wartchow et al. (2013b). **S**: (Wartchow et al. 2013b) (UFRN-Fungos, JPB) – [105/2/2] (7–)8–11(–11.5) × (5.4–)5.7–6.8(–7.2) µm, [**L** = 8.9–9.9 µm; **L'** = 9.5 µm; **W** = 6.3–6.4 µm; **W'** = 6.4 µm; Q = (1.21–)1.25–1.66(–1.68); **Q** = 1.41–1.53; **Q'** = 1.49].

20. *A. xerocybe* Bas – **Brazil**: Amazonas (Bas 1978). **Guiana** (Simmons et al. 2002). **N**: In the protologue, Bas (1978) states "in Campanirana vegetation..., forming ectomycorrhiza with Sapotaceae and/or Leguminosae". Simmons et al. (2002) describe the habitat of the Guiana material as follows: "Riverine swamp forest and adjacent slope forest dominated by *Dicymbe corymbosa*...and other mixed

hardwoods, on sand[y] soils with thick organic accumulations and on exposed sandstone and cliff boulders". **S**: (Simmons et al. 2002) from Guyanese materials – [49/3/3] 6.0–9.0 × 6.0–8.6 (–9.4) [typographic error?] µm, (Q = 1.0–1.1; **Q'** = 1.03–1.04). Bas (1978) from holotype and isotype – [10/1/1] 7.8–9.1 (–9.7) × 7.6–9.1 (–9.5) µm (Q = 1.0–1.05).

21. *A. xylinivolva* Tulloss, Ovrebo & Halling – **Colombia** (Tulloss et al. 1992). **Costa Rica** (Tulloss et al. 2011). **Mexico** [Guzmán & Varela 1978 as *A. gemmata* (Fr.) Bertillon *in* Dechambre]. **USA**: SE Arizona (Tulloss 2005). **N**: In South America, this taxon occurs in forest of *Quercus humboldtii* from Andean Colombia. **S**: (Tulloss et al. 1992; Tulloss & Possiel 2007), from isotype and paratype (COL, CSU, F, NY, PSO, RET, SFSU, TLXM) – [568/28/16] (6.2–) 8.0–10.2 (–12.2) × (5.2–) 7.2–9.5 (–10.8) µm; [**L** = (8.5–) 8.6–9.5 (–9.8) µm; **L'** = 9.1 µm; **W** = 7.9–8.8 (–9.3) µm; **W'** = 8.4 µm; Q = (1.00–) 1.02–1.18 (–1.39); **Q** = 1.05–1.11 (–1.15); **Q'** = 1.09].

B. **Section *Caesareae*** – No known from South America.

C. **Seção *Vaginatae*** – 13 taxa listed, with conservator account 11, with 4 taxa from Brazil and Guyana.

22. *A. antillana* Dennis – **Trinidad**. **Guadalupe**. **Martinique** (Dennis 1952, Pegler 1983, Tulloss 1994). **N**: The protologue says only that *A. antillana* was found at sea level in sandy soil, potential symbionts are not mentioned. **S**: (Tulloss 1994) including holotype (K) – [60/2/2] (8.4–) 9.8–13.2 (–14.3) × (7.1–) 7.8–10.5 (–11.9) µm, [**L** = 10.7–11.2 µm; **L'** = 11.0 µm; **W** = 9.1–9.4 µm; **W'** = 9.2 µm; Q = (1.05–) 1.08–1.36 (–1.42); **Q** = 1.14–1.24; **Q'** = 1.21].

23. *A. coacta* Bas – **Brazil**: Amazonas (Bas 1978), São Paulo (Menolli et al. 2009). N: In the protologue, Bas (1978) states that the species occurs "in secondary tropical rain forest" and that the only nearby woody plants with ectotrophic roots were *Neea* and *Psychotria* L. (Rubiaceae). **S**: (Bas, 1978) from holotype and isotype (INPA, L) – [10/1/1] 8.5–10 × 6.5–7.5 µm, (Q = 1.25–1.4; **Q** = 1.30).). Menolli et al. (2009) – [340/17/16] 8.7–10(–11.2) × (6.2–)7.5–8.7(–10) µm [**L** = 8.05–10.4; **L'** = 9.46; **W** = 6.85–8.4; **W'** = 7.76; Q = (1.12–)1.15–1.33(–1.4); **Q** = 1.17–1.3; **Q'** = 1.22].

24. *A. colombiana* Tulloss, Ovrebo & Halling – **Colombia** (Tulloss et al. 1992). **Costa**

Rica (Tulloss, t.b.p.). **N**: This is the only species of section *Vaginatae* with friable volva initially bright red. In South America, it occurs under *Quercus humboldtii* Bonpl. from Andean Colombia. **S**: (Tulloss et al. 1992) from isotype and paratypes (HUA, NY) – [126/5/4] (9.0–) 10.0–12.8 (– 14.5) × (8.5–) 95–12.2 (– 14.0) µm, [**L** = 10.8–11.9 µm; **L'** = 11.4 µm; **W** = 10.5–11.3 µm; **W'** = 11.0 µm; Q = 1.00 –1.08 (– 1.17); **Q** = 1.03–1.05; **Q'** = 1.04].

25. *A. craseoderma* Bas – **Brazil**: Amazonas (Bas 1978), Rondônia (Capelari & Maziero 1988). **Ecuador** [Lunt & Hedger 1996 as *A. craseodermata* (sic)]. **Martinique** (Pegler 1983). **N**: In the protologue, Bas (1978) states "in primary forest...in terra firma forest on yellow-soil hylaea, with Lecidithaceae, Leguminosae and other dicotyledonous trees, few Palmae." **S**: (Bas, 1978) from holotype (INPA, L) – [10/1/1] 7.5–9 × 7–8 µm; Q = 1.05–1.15; **Q** = 1.10).

26. *A. crebresulcata* Bas – **Brazil**: Amazonas (Bas 1978), Pernambuco (Wartchow & Maia 2007). **N**: In the protologue, Bas (1978) states "in mixed secondary growth tropical rain forest, growing near *Neea* [an ectomycorrhizal connection established] and *Psychotria* (Rubiaceae); also present Sapindaceae, Euphorbiaceae, Leguminosae, Palmae, Glacourtiaceae, Sapotaceae and Violaceae". **S**: (Wartchow & Maia 2007) from material of Pernambuco (URM) – [40/2/1] 8–10.5 (–11.5) × 7–9 (–9.5) µm, [**L'** = 9.1 µm; **W'** = 8.2 µm; Q= (1.06–) 1.10–1.26 (–1.33); **Q'** = 1.17]; Bas (1978) from holotype, isotype and paratype (INPA, L) – [70/7/4] (8–) 8.5–10.5 (–11) × (6.5) 7–8.5 (–9) µm, [Q = (1.05–) 1.10–1.40; **Q** = 1.15–1.30].

27. *A. fuligineodisca* Tulloss, Ovrebo & Halling – **Colombia** (Tulloss et al. 1992). **Costa Rica** (Tulloss et al. 2011). **N**: In South America, this taxon only occurs under *Quercus humboldtii* from Andean Colombia. **S**: (Tulloss et al. 1992, Tulloss unpubl. data) from holotype, isotype and paratype (CSU, F, NY, RET) – [945/47/27] (7.5–) 9.0–12.0 (–15.5) × (6.5–) 8.4–11.2 (–15.0) µm, [**L** = (9.5–) 9.6–11.4 (–11.5) µm; **L'** = 10.7 µm; **W** = (8.6–) 8.9–10.7 µm; **W'** = 9.9 µm; Q = (1.00–) 1.02–1.17 (–1.40); **Q** = (1.05–) 1.06–1.12 (–1.15); **Q'** = 1.08].

28†. *A. gayana* (Mont.) Mont. – **Chile** (Schalkwijk & Jansen 1982, Garrido & Bresinsky 1985). **N**: The original description only included color plates and references, but no material examined. This species might belongs to sect. *Phalloideae* (see below).

29. *A. humboldtii* Singer – **Colombia** (Singer 1963, Guzmán & Varela 1978, Tulloss et

al. 1992). **Costa Rica** (Tulloss unpubl. data). **N**: In South America, this taxon only occurs under *Quercus humboldtii* from Andean Colombia. **S**: (Tulloss et al. 1992) from holotype (BAFC) – [77/2/2] (10.2–) 11.0–14.0 (–15.5) × (9.0–) 9.8–13.0 (–13.3) µm, (**L** = 12.5–12.8; **L’** = 12.7 µm; **W** = 11.4–11.9 µm; **W’** = 11.7 µm; Q = (1.00–) 1.01–1.20 (–1.28); **Q** = 1.08–1.09; **Q’** = 1.09).

30. *A. lippiae* Wartchow & Tulloss – **Brazil**: Pernambuco (Wartchow et al. 2009). N: in the original description, this species was described as growing in sandy soil under ‘alecrim-de-cheiro’ (a species of *Lippia* L.) in an area characterized as ‘campo rupestre’ in the Brazilian semi-arid. S (Wartchow et al. 2009) from holotype and isotype (URM, RET) – [167/4/1] (9–) 10–21 (–22) × (6.5–) 7–11 (–12.4) µm, [**L** = 13.2–13.9 µm, **L’** = 13.5 µm; **W** = 7.3–8.2 µm, **W’** = 7.7 µm; Q = (1.33–) 1.38–2.32 (–2.35); **Q** = 1.72–1.86, **Q’** = 1.75].

31. *A. pseudospreta* Raithelh. – **Argentina** (Raithelhuber 1986, 1991, Tulloss & Halling 1997). **Chile** (Moncalvo & Tulloss unpubl. data). **N**: As occurs with *A. lanivolva*, was found a bulb covered by saccate volva in one fresh specimen of this taxon, for this reason, the species will need to be transferred to *Amanita* sect. *Amanita* (see above). Occurring in forest of *Nothofagus dombeyi* e *Chusquea*. **S**: (Tulloss & Halling 1997, Tulloss & Horak unpubl. data) from holotype and isotype (BAFC, ZT) – [114/5/2] (8.2–) 9.0–11.2 (–12.2) × (7.2–) 7.8–10.2 (–11.2) µm, [**L** = 9.6–10.7 µm; **L’** = 10.0 µm; **W** = 8.4–9.6 µm; **W’** = 9.0 µm; Q = (1.00–) 1.03–1.24 (–1.56); **Q** = 1.10–1.15; **Q’** = 1.12].

32. *A. sororocula* Tulloss, Overbo & Halling – **Colombia** (Tulloss et al. 1992). **Costa Rica** (Tulloss et al. 2011). **N**: The name *A. inaurata* f. *americana* E.J. Gilbert was misapplied by Singer (1963) and Pulido (1983) for the present species. In South America, this taxon only occurs under *Quercus humboldtii* from Andean Colombia. **S**: (Tulloss et al. 1992, Tulloss unpubl. data) including isotype and paratypes (BAFC, F, HUA, NY, RET) – [420/18/14] (7.8–) 9.5–14.0 (–17.0) × (7.2–) 8.8–12.8 (–15.5) µm, [**L** = (10.2–) 10.3–12.1 (–13.0) µm; **L’** = 11.2 µm; **W** = (9.5–) 9.6–11.5 (–12.2) µm; **W’** = 10.5 µm; Q = (1.00–) 1.02–1.16 (–1.,33); **Q** = 1.05–1.11 (–1.15); **Q’** = 1.07].

33. *A. tenacipulvis* Wartchow – **Brazil**: Amazonas (Wartchow 2015). **N**: a species recently described from a material deposited more than 30 years ago at F. It was collected from Amazonian campinarana, also known as ‘Amazonian caatinga’, due to

the frequent presence of shrubby trees on sandy soil poor in nutrients. Growing solitary near leguminosae and *Glycoxylon* sp. **S**: (Wartchow 2015) from holotype (F) – [40/1/1] 8–10.5(–11) × (7–)7.5–9.5 (–10) µm, [**L** = 9.4 µm; **W** = 8.5 µm; Q = 1.00–1.22(1.29); **Q** = 1.10].

34†. *A. vaginata* (Bull.: Fr.) Lam. *sensu lato* – **Argentina**. **Uruguay** (Garrido & Bresinsky 1985). **N**: Undoubtedly, this is not a correct application. The name applies to a European species that is, unfortunately, not well understood. The species to which this name has been applied should be treated as unknown.

II. Subgenus *Lepidella*

D. **Section *Amidella*** – None known from South America

E. **Section *Lepidella*** (Subseção *Vittadiniae*) – 10 taxa listed, with conservator account 10, with 3 taxa from Brazil and Guyana

33. *A. ameghinoi* (Speg.) Singer – **Argentina** (Bas 1969, Raithelhuber 1986). **Brazil**: São Paulo (Pegler 1997). **Uruguay** (Tulloss unpubl. data). **N**: Occurs in the pampas without apparent woody symbionts or in small forest fragments. **S**: (Tulloss & Horak t.b.p.) from materials of Argentina and Uruguay (BAFC, BPI) – [40/2/1] (10.0–) 10.2–12.8 (–14.8) × (7.8–) 8.0–10.0 (–10.8) µm, [**L** = 11.6 µm; **L’** = 11.6 µm; **W** = 9.0–9.1 µm; **W’** = 9.1 µm; Q = (1.12–) 1.18–1.44 (–1.56); **Q** = 1.26–1.30; **Q’** = 1.28]; Bas (1969) measured from the holotype (LPS) – [10/1/1] 11–13 (–13.5) × 10–15 µm, (Q = 1.20–1.35; **Q** = 1.30).

34. *A. aureofloccosa* Bas – **Brazil**: Rio Grande do Sul (Wartchow & Cortez 2015). **Colombia** (Palacio et al. 2014). **N**: Solitary or scattered on soil of subtropical semideciduous seasonal forest in southern Brazil. **S**: (Wartchow & Cortez 2015) of material from Brazil (URM) – [90/2/2] (5.5–)6.5–10.5(–11.0) 9 (5.5–) 6.5–10.0(–11.0) µm, [**L** = 7.7–8.3 µm, **L’** = 7.9 µm; **W** = 7.4–7.9 µm, **W’** = 7.6 µm; Q = (1.00–)1.02–1.13(–1.14); **Q** = 1.04–1.05, **Q’** = 1.04]. According to Bas (1969) from lectotype (BR) – [20/1/1] (6.0–) 7.0 –8.5 (–9.0) × (6.0–) 6.5–8.5 µm, (Q = 1.0–1.10).

35. *A. boliviana* Bas *nom. prov.* – **Bolivia** (Bas 1969). **N**: Only one specimen known, from forest in Bolivia. **S**: (Bas 1969) (L) – [20/1/1] (6.5–) 7–8.5 × (5.5–) 6–7 (–7.5) µm, (Q = 1.1–1.35; **Q** = 1.20).

36. *A. bubalina* Bas – **Argentina** (Bas 1969, Raithelhuber 1986, 1991). **N**: Known from a single collection found in forest at 1000 m elevation. **S**: (Bas 1969) from holotype (L) – [20/2/1] (6.5–) 7–9 (–9.5) × 5–6.5 µm, (Q = 1.20–1.50; **Q** = 1.30-1.35).

37. *A. foetens* Singer var. *foetens* – **Argentina** (Singer 1953, Bas 1969, Raithelhuber 1986). **N**: Bas (1969) states “in fields and forests”. **S**: (Tulloss & Horak unpubl. data) from holotype (LIL) – [20/1/1] (7.2–) 7.5–9.5 × (6.0–) 6.8–8.2 (–8.5) µm, [**L** = 8.5 µm; **W** = 7.3 µm; Q = (1.00–) 1.09–1.29 (–1.32); **Q** = 1.16]. According to Bas (1969) from isotype and another specimen (BAFC, MICH) – [30/2/2] 8–9.5 × 7.5–9 µm, [Q = 1.00–1.10 (–1.20); **Q** not reported].

38. *A. foetens* var. *grassii* Raithelh. – **Argentina** (Raithelhuber 1986, 1991). **N**: The protologue states that the original material was found “in garden turf after torrential rains”.

39. *A. grallipes* Bas & de Meijer – **Brazil**: Paraná (Bas & de Meijer 1993, de Meijer 2006, 2008). **N**: this is the unique species of sect. *Lepidella* with predominant brown color. **S**: (Bas & de Meijer 1993) from holotype, isotype and paratype – [50/4/2] 7.5–9.5 × 5.5–7 (–7.5) µm, [Q = (1.15–) 1.20–1.50 (–1.60), **Q** = 1.25–1.40].

40. *A. lilloi* Singer – **Argentina** (Singer & Digilio 1952, Bas 1969). **Brazil**: Pernambuco (Wartchow et al. 2007). **N**: The type of this species was found in a garden; and the material recently found in Pernambuco was found in a public lawn. **S**: (Wartchow et al. 2007) of material from Pernambuco, Brazil (URM) – [100/5/2] (7.0–) 7.5–9.5 (–10.5) × (6.0–) 6.5–7.5 (–8.0) µm, [**L** = 8.0–8.6 µm; **L’** = 8.3 µm; **W** = 6.8–7.0 µm; **W’** = 7.0 µm; Q = (1.11–) 1.14–1.36 (–1.43); **Q** = 1.16–1.22; **Q’** = 1,20]. Bas (1969) from isotype (MICH) – [25/1/1] (6.5–) 7.0–8.5 × (5.5–) 6.0–7.0 (–7.5) µm, (Q = 1.10–1.35; **Q** = 1.20). Tulloss (unpubl. data) of materials from Argentina (BAFC) and Brazil (RET) – [69/4/3] (6.5–) 6.9–9.3 (–10.5) × (5.0–) 5.4–7.4 (–8.1) µm, [**L** = 7.2–8.6 µm; **L’** = 8.1 µm; **W** = 5.9–7.0 µm; **W’** = 6.5 µm; Q = (1.08–) 1.14–1.43 (–1.50); **Q** =1.22–1.35; **Q’** = 1.26].

41. *A. prairiicola* Peck – **Argentina** (Bas 1969, Raithelhuber 1986, Tulloss & Horak, unpubl. data). **N**: This species is known in Argentine from a single specimen found in human-altered landscape. The type locality of the species is in the state of Kansas, EUA; and, with the exception of the Argentine collection, the range is restricted to North America, from the high grass prairies of the central plains to the western, high

elevation deserts. It is often reported from areas with no potential woody plant symbionts. Probably not indigenous to South America and may not be found there in unaltered environments (Tulloss 2007b). **S**: (Tulloss 1998 unpubl. data, Tulloss & Horak unpubl. data) including holotype and paratypes (BAFC, BPI, FH, MICH, NY, NYS, RET, VPI) – [640/31/10] (8.0–) 10.0–14.0 (–19.2) × (5.2–) 6.4–10.0 (–12.2) µm, [**L** = (10.4–) 11.0–13.3 (–13.7) µm; **L’** = 12.0 µm; **W** = (6.5–) 6.6–9.6 (–9.7) µm; **W’** = 8.0 µm; Q = (1.09–) 1.26–1.82 (–2.31); **Q** = (1.30–) 1.33–1.75 (–1.85); **Q’** = 1.51].

42. *A. singeri* Bas – **Argentina** (Bas 1969) (=*A. salmonophylla* Singer *ad int.*). **N**: This species seems to be native to Mediterranean Europe or to the Mediterranean region in general. In Europe, this taxon occurs in pastures and other deforested areas. It was only found in Argentina twice; both occurrences were in garden environments. Probably not indigenous to South America and may not be found in unaltered environments (Tulloss 2007c). **S**: (Tulloss & Horak unpubl. data) of paratype and materials from France (BAFC, RET) – [178/10/7] (6.0–) 7.5–11.0 (–15.4) × (4.5–) 4.9–7.5 (–9.5) µm, [**L** = (7.1–) 7.6–10.0 µm; **L’** = 9.1 µm; **W** = (4.9–) 5.6–7.2 µm; **W’** = 6.6 µm; Q = (1.12–) 1.21–1.60 (–2.00); **Q** = 1.23–1.42 (–1.60); **Q’** = 1.39]. Bas (1969) of holotype and paratype (BAFC) – [30/4/2] 7–9 (–10.5) × 5–7 (–7.5) µm, [Q = (1.10–) 1.20–1.45 (–1.55); **Q** = 1.25–1.35].

F. **Section *Lepidella*** (subsection *Solitariae*) – Four taxa listed, with conservator account 32. No taxon known for Brazil or Guyana.

43. *A. advena* Tulloss, Ovrebo & Halling – **Colombia** (Tulloss et al. 1992). **Costa Rica** (Tulloss et al. 2011). **N**: In South America (Andean Colombia), this taxon only occurs under *Quercus humboldtii* at 2500–3000 m elevation. **S**: (Tulloss et al. 1992) of holotype (NY) – [65/2/1] (8.5–) 9.0–12.5 (–14) × (6.5–) 7.0–9.5 (–10.2) µm, [**L** = 10.5–10.7 µm; **L’** = 10.6 µm; **W** = 8.2–8.3 µm; **W’** = 8.2 µm; Q = (1.10–) 1.11–1.57 (–1.62); **Q** = 1.29–1.30; **Q’** = 1.30].

44. *A. crassa* Bas – **Argentina** (Bas 1969, Raithelhuber 1986). **N**: Argentine material once determined as *A. chlorinosma* or *A. ravenelii* in Singer’s notebooks (F) has all been redetermined as *A. crassa* by Bas (see in excluded taxa section). Ecological information for this species is lacking. The holotype of the species was reportedly found on dung. Considering the subsectional placement by Bas, the species is very likely to be ectomycorrhizal. **S**: Bas (1969) of holotype (BAFC) – [20/1/1] (6.5–) 7.0–

9.0 × 4.5–6.0 µm (Q = 1.30–1.80; Q = 1.50).

45†. A. *fernandeziana* Singer *ad int*. – **Chile** (Singer 1962). **N**: The Pacific island (Masatierra, Chile) on which this species was found may lack mycorrhizal woody plants. Singer did not identify a potential host for this species. Perhaps, it may belong with other taxa in subsection *Vittadiniae* that appear to occur with mycorrhizal symbionts. No information concerning the spores of the species is known.

46. A. *viridissima* Wartchow – **Brazil**: Bahia (Wartchow 2016). **N**: This species is known in Brazil from a single specimen found on clay soil in a 'misty forest' (sensu Zappi et al. 2003) about 1700 m alt. According to these authors, *Guapira obtusata* (Jacq.) Little (1000–1850 m alt.) and *Coccoloba brasiliensis* Nees & Mart. (1000–1700 m alt.) are putative ECM trees reported as found in similar altitude to our new species. **S**: (Wartchow & Cortez 2016) from holotype (JPB) – [40/1/1] (9–)9.8–13(–13.5) × (5.5–)5.7–8.3(–8.5) µm; [**L** = 11.5 µm; **W** = 6.3 µm; Q = (1.42–)1.53–2.12(–2.27); **Q'** = 1.82].

G. **Section *Lepidella*** (subsection *Gymnopodae*) – No taxon known for South America. However at least one species of this subseção has been reported from Costa Rica: *A. conara* Tulloss, Halling & G. M. Muell. (Tulloss et al. 2011).

H. **Section *Lepidella*** (subsection *Limbatulae*) – No taxon known for South America.

I. **Seção *Phalloideae*** – 5 taxa listed, with 2 taxa from Guyana and Brazil.

45. *A. arocheae* Tulloss, Ovrebo & Halling – **Colombia**, **Costa Rica**, **Mexico** (Tulloss et al. 1992). **N**: In South America (Andean Colombia), this taxon occurs at 2500 m elevation under *Quercus humboldtii* in loamy soil and under *Trigonobalanus* (=*Colombobalanus*) *excelsa*. It has also been reported to occur in Mexico in mesophytic, montane woods (*Pinus* and *Quercus* forests). **S**: (Tulloss et al. 1992, Tulloss 2011) also from isotype and paratype (FCME, NY, RET) – [250/12/10] (5.8–) 7.2–10.0 (–12.8) × (5.5–) 6.8–9.5 (–12.0) µm; [**L** = (7.5–) 8.1–9.6 µm; **L'** = 8.7 µm; **W** = (7.1–) 7.6–8.9 µm; **W'** = 8.2 µm; Q = 1.0–1.13 (–1.27); **Q** = 1.04–1.08 (–1.10); **Q'** = 1.06].

46. *A. aurantiobrunnea* C. Simmons, T.W. Henkel & Bas – **Guyana** (Simmons *et al.* 2002). **N**: Simmons et al. (2002) describe the habitat of this species as follows: "Slope

forest dominated by *Dicymbe corymbose* (Paluwayek), on grey sands”. **S**: (Simmons et al. 2002) from holotype and paratypes (BRG, L) – [65/5/5] (6.2–) 6.8–9.4 × (5.0–) 5.5–7.5 µm, [Q = (1.00–) 1.1–1.35 (–1.45); **Q** = (1.10–) 1.15–1.35].

47. *A. aureomonile* Tulloss & Franco-M. – **Colombia** (Tulloss *et al.* 1992). **N**: Known only in forest of *Trigonobalanus excelsa* (1900–2000 m elevation) from Andean Colombia. The mushroom, as well its associated tree might have a “Malayo-American” origin (Tulloss 2005). **S**: (Tulloss et al. 1992) from holotype (CUVC): [60/2/1] (5.0–) 5.5–7.5 (–7.8) × (4.8–) 5.0–6.5 (–6.8) µm, **L** = 6.6–6.7 µm; **L’** = 6.7 µm; **W** = 5.8–6.0 µm; **W’** = 5.9 µm; Q = (1.00–) 1.03–1.24 (–1.31); **Q** = 1.12–1.15; **Q’** = 1.13). In the protologue, this species is said to occur in moist *Nothofagus* forest with *Chusquea*. (Tulloss & Horak unpubl. data) from holotype and isotype (BAFC, ZT) – [60/1/1] (8.5–) 8.8–10.8 (–12.5) × (7.4–) 7.7–9.5 (–11.0) µm, [**L** = 9.9 µm; **W** = 8.8 µm; Q = (1.02–) 1.06–1.20 (–1.27); **Q** = 1.13].

48. *A. phalloides* (Fr.: Fr.) Link *in* Willd. f. *phalloides* – **Argentina** (Raithelhuber 1986, 1991, Valenzuela et al. 1992). **Chile** (Garrido & Bresinsky 1985). **Uruguay** (Herter 1934). **N**: (=*A. phalloides* f. *quercus-ilicis* Herter). This well-known species has been introduced throughout the world by importation of tree symbionts. Herter’s name was applied to material collected under the exotic European *Quercus ilex*. In Europe, the species occurs with *Quercus*, various genera of domesticated and wild nut trees, members of the Pinaceae, etc. **S**: (Tulloss unpubl. data) from material of several parts of the world (BAFC, DAVFP, IB, L, NMLU, O, P, RET) – [296/15/14] (7.5–) 8.0–10.1 (–13.5) × (5.5–) 6.1–8.0 (–10.5) µm, [**L** = 8.3–9.3 (–9.5) µm; **L’** = 8.9 µm; **W** = (6.4–) 6.8–7.4 µm; **W’** = 7.1 µm; Q = (1.03–) 1.12–1.47 (–1.70); **Q** = 1.20–1.33 (–1.40); **Q’** = 1.26].

49. *A. psammolimbata* Wartchow & Sulzbacher – **Brazil**: Rio Grande do Norte (Wartchow et al. 2015). **N**: Wartchow et al. (2002) describe the habitat of this species as follows: “Growing on soil in coastal sandy dune of Atlantic Forest, surrounded by *Coccoloba* and others. **S**: (Wartchow et al. 2015) – [30/1/1] (8–) 9–11.5 × 5–7 (–7.5) µm, [**L** = 10.1 µm; **W** = 6.3 µm; Q = (1.33–) 1.34–1.83 (–1.91); **Q** = 1.61].

J. **Seção *Validae*** – 10 taxa listed, conservative account 8, with 4 or 5 taxa from Brazil or Guyana.

50. *A. brunneolocularis* Tulloss, Ovrebo & Halling – **Colombia**. (Tulloss et al. 1992). **Costa Rica** (Tulloss et al. 2011). **N**: In South America (Andean Colombia, this taxon occurs in mixed forest dominated by *Quercus humboldtii*. **S**: (Tulloss et al. 1992) including isotype and paratypes (CSU, F, NY, RET) – [258/10/6] (6.5–) 7.5–10.0 (–12.5) × (5.0–) 5.8–7.8 (–9.0) µm, [**L** = (8.3–) 8.4–9.4 µm; **L’** = 8.8 µm; **W** = (6.1–) 6.3–7.0 µm; W’ = 6.7 µm; Q = (1.05–) 1.17–1.47 (–1.69); **Q** = 1.27–1.34 (–1.36); **Q’** = 1,31].

51†. *A. bulbosa* var. *citrina* (Schaeff. : Fr.) Gillet – **Uruguay** [Garrido & Bresinsky 1985 as *A. citrinia* (Schaeff. : Fr.) Pers.]. **N**: (≡ *Agaricus citrinus* Schaeff.: Fr. *non* Gunnerus) In no known case has the proposed export of this species from Europe proven to be actual. Therefore, it is improbable that the species would be found in Uruguay. **S**: (Tulloss unpubl. data) from European materials (RET) – [40/2/1] (6.9–) 7.5–10.0 (–16.0) × (6.0–) 7.0–8.8 (–10.4) µm, [**L** = 8.1–8.7 µm; **L’** = 8.4 µm; **W** = 7.4–7.9 µm; **W’** = 7.6 µm; Q = (1.03–) 1.05–1.15 (–1.54); **Q** = 1.10; **Q’** = 1.10].

52. *A. campinaranae* Bas – **Brazil**: Amazonas (Bas 1978, Singer &Araújo 1979). **N**: In the protologue, Bas states “Terrestrial in Campinarana vegetation under Leguminosae and Sapotaceae in Amazinas, forming ectotrophic mycorrhiza”. **S**: (Bas, 1978) from holotype (INPA) and isotype (L) – [10/1/1] 5.6–6.7 × 5.5–6.5 µm, (Q = 1.00–1.15; **Q** = 1.05).

53. *A. cyanopus* C. Simmons, T.W. Henkel & Bas – **Guyana** (Simmons et al. 2002). **N**: Simmons et al. (2002) described the habitat of this species as follows: “On root mat, but rooting [stipe radical extending] into mineral soil, in forest of predominantly *Dicymbe corymbosa*”. **S**: (Simmons et al. 2002) from holotype (BRG) – [25/1/1] 7.4–8.7 (–9.0) × (5.0–) 5.6–7.4 µm, [Q = (1.15–) 1.25–1.45 (–1.60); **Q** = 1,36].

54†. *A. excelsa* (Fr.: Fr.) Bertillon *in* DeChambre – **Brazil** (Rick 1906, 1937 as *A. spissa* Fr., Garrido & Bresinsky 1985). **N**: In most cases, the supposed export of this species from Europe has proven to be false. Therefore, it is improbable that the species would be found in Brazil. **S**: (Tulloss unpubl. data) from materials from Norway (O, RET) – [40/2/1] (7.0–) 7.5–10.5 (–13.5) × (5.3–) 5.8–7.5 (–8.6) µm, [**L** = 8.3–9.4 µm; **L’** = 8.9 µm; **W** = 6.2–6.9 µm; **W’** = 6.6 µm; Q = (1.23–) 1.24–1.52 (–1.57); **Q** = 1.34–1.36; **Q’** = 1.35].

55. *A. flavoconia* var. *inquinata* Tulloss, Ovrebo & Halling – **Colombia** (Tulloss et al.

1992). **Costa Rica** (Tulloss et al. 1992). **Mexico** (Tulloss *et al.* 1992). [=*A. flavoconia* var. *sinapicolor* Tulloss, Ovrebo & Halling (Tulloss et al. 1992, Tulloss 2005)]. **N**: In South America (Andean Colombia), this taxon occurs in forest dominated by *Quercus humboldtii* at 1900–2500 m (or higher) elevation, in loamy soil. **S**: (Tulloss et al. 1992) from isotype, paratype and other materials from Central America (CSU, F, NY, RET, TLXM, XAL) – [665/32/13] (5.2–) 6.8–9.0 (–11.5) × (4.5–) 5.8–7.5 (–9.5) µm, [**L** = (6.9–) 7.3–8.4 (–8.8) µm; **L'** = 7.8 µm; **W** = (5.9–) 6.0–7.0 (–7.1) µm; **W'** = 6.6 µm; Q = (1.00–) 1.06–1.37 (–1.73); **Q** = (1.12–) 1.14–1.28; **Q'** = 1.20].

56. *A. perphaea* C. Simmons, T.W. Henkel & Bas – **Guyana** (Simmons et al. 2002). **N**: Simmons et al. (2002) report the habitat of this species as follows: "Riverine and adjacent slope forest dominated by *Dicymbe corymbose,* with scattered hardwoods including *Caryocar* [F. Allam. *ex* L.] *sp.* [Caryocaraceae]. In wet bottomlands on sandy soils with thick root mat and organic accumulations". They also report that spores are only common in the oldest specimens collected. This species is referred as edible in Guyana (Henkel et al. 2004). **S**: (Simmons *et al.* 2002) from holotype and paratype (BRG, L) – [40/5/2] (5.6–) 6.1–7.4 × 4.9–6.9 µm, [Q = 1.00–1.10 (–1.30); **Q** = 1.05–1.08].

57. *A. phaea* Bas *nom. prov.* – **Brazil**: Amazonas (Bas 1978). **N**: The single original basidiome was found in secondary growth tropical forest. No material of this species has ever been found that bore spores. Bas (1978) speculated that it might reproduce vegetatively.

58. *A. picea* Tulloss, Ovrebo & Halling – **Colombia** (Tulloss et al. 1992). **N**: In South America (Andean Colombia), this taxon occurs in forest dominated by *Quercus humboldtii* in loamy soil (at 2700 m elevation). **S**: (Tulloss et al. 1992) from isotype and paratype (NY) – [127/6/2] (7.5–) 8.8–11.2 (–12.5) × (5.5–) 6.5–8.2 (–9.0) µm, [**L** = 9.3–10.6 µm; **L'** = 10.1 µm; **W** = 6.9–7.5 µm; **W'** = 7.2 µm; Q = (1.11–) 1.28–1.60 (–1.74); **Q** = 1.35–1.47; Q' = 1.40].

59. *A. rubescens* Pers.: Fr. – **Argentina** (Raithelhuber 1986, Tulloss & Horak t.b.p.). **Chile** (Garrido 1986). **N**: This species has been confirmed as an associate of imported trees (*Quercus*) in Argentina (e.g., Tulloss & Horak, s.p.) and Chile (Garrido 1986). In Colombia, the name has been misapplied to *A. brunneolocularis* (Tulloss *et al.* 1992). In Brazil, Sobestiansky (2005) cited *A. rubescens*, that might be introduced with foreign trees. Several taxa were described [*A. brunneolocularis* [=*rubescens*

sensu Pulido], *A. novinupta* Tulloss & J. Lindgr., *A. orsonii* Ash. Kumar & T. N. Lakh., *A. rubescens* var. *alba* Coker, *A. congolensis* (Beeli) Tulloss B. E. Wolfe, K.W. Hughes, Kudzma, & Arora etc.] and can be confused with this European species. A revision of the material reported as "*A. rubescens*" in Brazil is necessary. **S**: (Tulloss unpubl. data) from materials of Europe and Chile (BAFC, IB, L, NMLU, O, RET) – [290/12/7] (7.0–) 8.0–10.6 (–12.5) × (5.2–) 5.5–7.0 (–8.0) µm, [**L** = (8.4–) 8.6–10.1 µm; **L'** = 9.2 µm; **W** = 6.0–6.6 (–6.7) µm; **W'** = 6.3 µm; Q = (1.20–) 1.31–1.67 (–1.87); **Q** = 1.37–1.56 (–1.58); **Q'** = 1.48].

III. **Sequestrate species** – there is only one known species.

1. *A. nouhrae* Truong, Kuhar & M. E. Sm – **Argentina** (Truong et al. 2017). **N**: a hypogeous ('truffle-like') species that occurs in deep soil under *Nothofagus antarctica* in northern Patagonia; associated with areas of animal digging. It is the only sequestrate species of *Amanita* known to the Americas (Truong et al. 2017). **S**: (Truong et al. 2017) from holotype, isotype and other materials (CORD, FLAS, SGO) –14–20 (–22) × (12–) 12.5–17.5 (–19) µm, (Q = 1.05–1.25), distinctly ornamented on the inner wall (crassospores).

Taxa insufficiently known

Bas (1969) already reported that names applied by Rick (1937, 1938) are inadequately described or exsiccates are very damage, and are considered *nomina dubia*. Other taxa must be considered poorly understood as follow:

1. *Armillaria bruchii* Speg. – Argentina (Bas 1969).
2. *Amanitopsis plumbea* Rick *non* (Jul. Schäff.: Purton) J. Schröt.– Brazil (Bas 1978).
3. *A. spissa* Fr. - Brazil (Rick 1906).
4. *A. spissa* var. *alba* Rick – Brazil (Rick 1906).
5. *A. spissa* var. *laeta* Rick – Brazil (Rick 1906). N: Bas (1969) and Garrido & Bresinsky (1985) believed that name is synonym of A. *singeri*. On the other hand, Bas & de Meijer (1993) suspected that it is synonym of *A. grallipes*.

Excluded taxa

1. *A. bresadolae* (Rick) Rick – **Brazil**. Species later described as *Lepiota crassior* Singer (Singer 1953).

2. *A. chlorinosma* (Peck) Lloyd – Singer originally identified material of *A. crassa* under this name and then changed the name to *A. ravenelii* (see below). In preparing his thesis (Bas 1969) corrected the determination. Singer's notebooks seem to be the source of claiming *A. chlorinosma* for Argentina.

3. *A. inaurata* f. *argentina* Raithelh. *nom. inval.* – Raithelhuber deposited no material in BAFC or ZT under the name *A. inaurata* or any of its synonyms. He described the species as having a bulb within a "double" volva. Considering the number of times *A. ushuaiensis* has apparently been renamed. It seems possible that its plasticity prevented Raithelhuber from recognizing it. At any rate, with no available material we cannot establish any facts.

4. *A. ravenelii* (Berk. & Curt.) Sacc. – **Argentina** (Raithelhuber 1986, have doubts about the occurrence of this species). **N**: Singer identified collections of *A. crassa* under this name. Bas corrected the identification in preparing his thesis (Bas 1969). Singer's notebooks seem to be the source of claiming *A. ravenelii* for Argentina.

5. *A. strobiliformis* (Paulet *ex* Vitt.) Quél. – **Argentina** (Raithelhuber 1986, Garrido & Bresinsky 1985). **N**: Tulloss & Horak (t.b.p.) have not found any material deposited under this name in BAFC or ZT.

6. *A. umbrinella* E.-J. Gilbert & Cleland – **Chile** (Horak 1979, Raithelhuber 1986, Garrido 1988). **N**: Singer originated the application of this name of an Australian species in Argentina. The senior author analyzed several exsiccates originated from Argentina, and probably corresponds to other taxon.

7. *A. vittadinii* (Moretti) Vitt. – **Argentina** (Garrido & Bresinsky 1985). **N**: No material under this name was localized at BAFC. Singer and others applied this European name to Argentine emdemic species of *Amanita* subsection *Vittadiniae*. Bas corrected any such identifications in preparing his thesis (Bas 1969). It is very unlikely that *A. vittadinii* appears in the New World.

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ANEXO A – FICHA DE COLETA DE ESPÉCIES DE *AMANITA*

Appendix A2: Collecting Notes for Species of *Amanita*

Developed by R. E. Tulloss, P.O. Box 57, Roosevelt, NJ 08555-0057.
Suggestions and improvements are solicited.

Date of Collection:

Name of Collector(s):

Collector's Collection No.:(if assigned)

Field Diagnosis:

Locale of Collection:Park/Town/Borough/etc.

County State/Province Country

Type of Soil:

Species of Trees and other vegetation around collecting site:

Other comments on site ecology, collecting conditions, etc.:

PILEUS: Diam.: Thickness. Color(s):

Shape (describe changes during expansion if possible, include inflexed or decurved margin, umbo, etc.):

Striate? Y N Length of Striation [Give a range of values when dealing with multiple basidiocarps. It is convenient to provide the information as a fraction (without computing the result) such as 14/43, where 43 is the radius of the pileus with 14 mm long striation.]: Appendiculate? Y N

Form of appendiculate material:

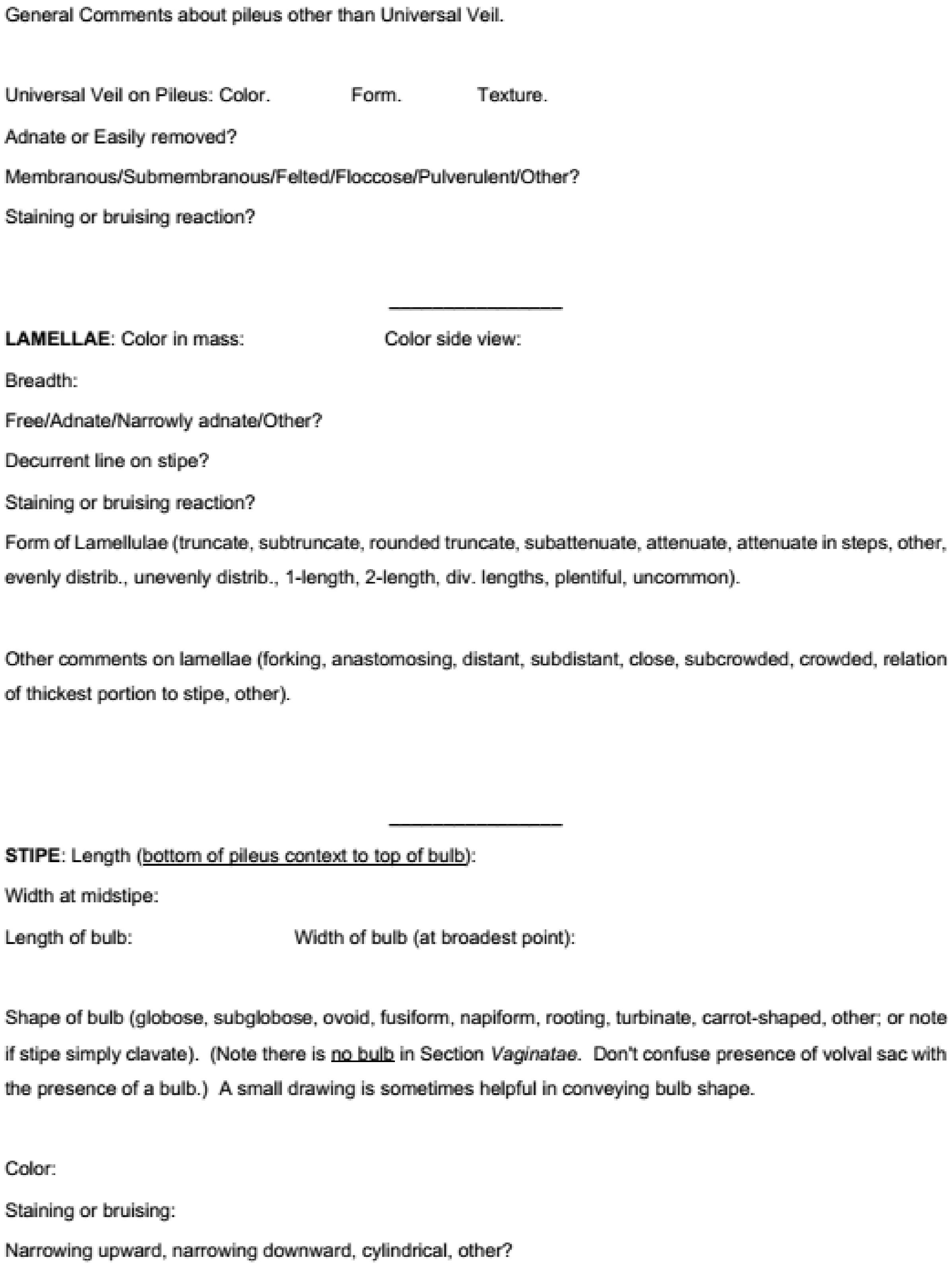
Dry/Viscid/Tacky/Shiny/Dull?

Odor? (Give it a name if possible.) Taste? (Give it a name if possible.)

Surface staining or bruising reactions?

Context color: Context staining:

Describe how the context thins from stipe to margin. (For example, ``slowly at first, then rapidly to a membrane for the last 1 cm nearest margin.")



General Comments about pileus other than Universal Veil.

Universal Veil on Pileus: Color. Form. Texture.

Adnate or Easily removed?

Membranous/Submembranous/Felted/Floccose/Pulverulent/Other?

Staining or bruising reaction?

LAMELLAE: Color in mass: Color side view:

Breadth:

Free/Adnate/Narrowly adnate/Other?

Decurrent line on stipe?

Staining or bruising reaction?

Form of Lamellulae (truncate, subtruncate, rounded truncate, subattenuate, attenuate, attenuate in steps, other, evenly distrib., unevenly distrib., 1-length, 2-length, div. lengths, plentiful, uncommon).

Other comments on lamellae (forking, anastomosing, distant, subdistant, close, subcrowded, crowded, relation of thickest portion to stipe, other).

STIPE: Length (bottom of pileus context to top of bulb):

Width at midstipe:

Length of bulb: Width of bulb (at broadest point):

Shape of bulb (globose, subglobose, ovoid, fusiform, napiform, rooting, turbinate, carrot-shaped, other; or note if stipe simply clavate). (Note there is no bulb in Section *Vaginatae*. Don't confuse presence of volval sac with the presence of a bulb.) A small drawing is sometimes helpful in conveying bulb shape.

Color:

Staining or bruising:

Narrowing upward, narrowing downward, cylindrical, other?

General Comments about pileus other than Universal Veil.

Universal Veil on Pileus: Color. Form. Texture.

Adnate or Easily removed?

Membranous/Submembranous/Felted/Floccose/Pulverulent/Other?

Staining or bruising reaction?

LAMELLAE: Color in mass: Color side view:

Breadth:

Free/Adnate/Narrowly adnate/Other?

Decurrent line on stipe?

Staining or bruising reaction?

Form of Lamellulae (truncate, subtruncate, rounded truncate, subattenuate, attenuate, attenuate in steps, other, evenly distrib., unevenly distrib., 1-length, 2-length, div. lengths, plentiful, uncommon).

Other comments on lamellae (forking, anastomosing, distant, subdistant, close, subcrowded, crowded, relation of thickest portion to stipe, other).

STIPE: Length (bottom of pileus context to top of bulb):

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Shape of bulb (globose, subglobose, ovoid, fusiform, napiform, rooting, turbinate, carrot-shaped, other; or note if stipe simply clavate). (Note there is no bulb in Section *Vaginatae*. Don't confuse presence of volval sac with the presence of a bulb.) A small drawing is sometimes helpful in conveying bulb shape.

Color:

Staining or bruising:

Narrowing upward, narrowing downward, cylindrical, other?

Flaring at apex?

Decoration on outer surface:

Presence, position, color, form, staining of annulus:

Color of context: Staining or bruising of context:

Hollow/Stuffed/Solid? Diam. central cyl.:

Form of stuffing material:

Color in worm or insect tunnels in context:

Universal veil material on stipe base:

a. Sac: Distance from stipe base to highest point of limb:

Thickness at midpoint between top and attachment:

Texture. Color. Layered?

Tough/Flimsy?

When longitudinal section is made, is a little, inner limb present? If so, make a drawing showing how and where the inner limb is attached to the outer limb and where the latter is attached to the stem.

b. Not evident.

c. In warts. (Describe size*, color, placement, etc. Do they seem to cause the presence of recurved scales on the top of the bulb?)

d. In a collar as in *Amanita pantherina*. (Describe size*, color, placement, etc.)

e. In broken collars as in *A. muscaria*. (Describe etc.)

f. In a loose limb against stipe. (Describe etc.) Give distance from base to topmost point of limb.

g. In loose patches easily left in the soil. (Describe etc.)

h. Other.

ORE PRINT: Color: Other comments:

color slides attached? Y N What identifying marks are on these slides?

If some or all of these reagents are available, color reactions of various part of the fruit body may prove useful:

Reagent Used	P. Surf./Cont.	Lam.	St. Surf./Cont.	U. v. on P.	U. v. on St.
__% KOH					
__% H_2SO_4					
__% NH_4OH					
__% $FeSO_4$					

Separate forms are provided for phenoloxidase spot testing with the following:

L-Tyrosine

Paracresol

Syringaldazine

Additional tests:

Wieland [Meixner] Test

Other