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AGARICALES FUNGI FROM ATLANTIC RAIN FOREST FRAGMENTS IN MINAS GERAIS, BRAZIL

Luiz Henrique Rosa[1*], Marina Capelari[2]

[1]Laboratório de Microbiologia, Departamento de Ciências Biológicas, Universidade Federal de Ouro Preto, Ouro Preto, MG, Brasil; [2]Seção de Micologia e Liquenologia, Instituto de Botânica, São Paulo, SP, Brasil.

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ABSTRACT

Two Atlantic Rain Forest fragments in Minas Gerais state were studied to access their *Agaricales* fungal richness. A total of 187 specimens were collected and 109 species, 39 genera, and eight families were identified. Thirty-three species were cited for the first time in Brazil.

Key words: *Basidiomycota*, biodiversity, Brazilian ecosystems, threatened environment

Agaricales (*Basidiomycota*), the gill fungi, can live in all different terrestrial ecosystems of the world and decay organic matter. The order includes saprotrophic, mycorrhizal, and pathogenic fungi that occur in various shapes, sizes, and colors. According to Hawksworth (7), there has been some, but not enough, progress in the exploration of fungi in tropical forests; the *Basidiomycota* of Brazilian ecosystems are poorly known, especially those of the order *Agaricales*. Furthermore, the mycobiota of some ecosystems of Minas Gerais state and other Brazilian regions have never been explored.

The *Agaricales*, clade euagarics of Hibbett & Thorn (8), is the most diverse order in the phylum *Basidiomycota*, with approximately 9,387 species, 347 genus and 26 families (10). They are a critical component of the degradation of organic matter, providing habitat and food for many organisms such as bacteria, other fungi, insects, and mammals. In addition, this group has received special attention from researchers in the last years due to their potential use in biotechnology (31) as a source of several metabolites with antimicrobial, cytotoxic, immunemodulator, and antiparasitic activities (3, 22, 23, 24), and as a food source that is rich in vitamins, protein, and enzymes (11).

The first records on the *Agaricales* from Minas Gerais state were published by Berkeley (1), Montagne (13), and Berkeley & Cooke (2). Pegler (15, 16) reviewed the Brazilian species published by these authors listing the following taxa from Minas Gerais state: *Gymnopus subpruinosus* (Murril) Desjardin et al. *Macrocybe praegrandis* (Berk.) Pegler & Lodge, *Xeromphalina tenuipes* (Schwein.) A.H. Sm., *Marasmiellus tricolor* (Alb. & Schwein.) Singer; *Marasmius ferrugineus* (Berk.) Berk., M. *weddellianus* Mont., *Trogia cantharelloides* (Mont.) Pat., and *Hohenbuehelia petaloides* (Bull.) Schulzer. Two species of *Mycena* are dubious: *M. asterocephala* (Mont.) Sacc., which, according to Pegler (16), probably belongs to *Mycena* section *Ianthinae*, closely allied to *M. pura* (Pers.) Kummer; and *M. atropurpurea* (Mont.) Sacc.

The aim of this paper is to present a list of species of *Agaricales* collected in two fragments of the Atlantic Rain Forest from Minas Gerais state and to contribute to the knowledge of the mycota in tropical Brazilian ecosystems.

***Corresponding Author. Mailing address:** Laboratório de Microbiologia, Departamento de Ciências Biológicas ICEB/UFOP. Rua Diogo Vasconcelos 122, Campus Cruzeiro, 35400-000, Ouro Preto, MG, Brazil.; E-mail: lhrosa@ufop.br

Basidiomycetes specimens were collected in the rainy season from November-1999 to March-2000 in two areas that represent important reservoirs for biodiversity and conservation research in Minas Gerais: the Ecological Station of the Universidade Federal of Minas Gerais (EEco), located at 19°52'S and 43º58'W, and the Rio Doce State Park (PERD), located at 19°48'18"-19°29'24"S and 42°32'30"-48°28'18"W. (9).

The basidiomata were examined in the field for macroscopic characteristics such as color, shape, surface and margin of pileus; color, density and characteristics of lamellae; and size, surface and color of stipe. The specimens were air-dried at temperatures between 38 and 55°C for later examination. The dried material was rehydrated with 70% ethanol and examined in 5% KOH and Melzer´s reagent. Microscopic characters (hyphal system, cystidia, basidia, and basidiospores) were observed with a light microscope (Olympus BX50). The identification was made using the pertinent literature and comparison with collections present at the State Herbarium Maria Eneyda P. Kauffmann Fidalgo (SP). The classification of families follows Singer (27). The descriptions of taxa and the key to the species are given by Rosa (21). All material was deposited at SP and BHCB herbaria (http://sciweb.nybg.org/science2/IndexHerbariorum.asp).

In this study a total of 187 specimens were identified, resulting in 109 species in 39 genera, and eight families of agaricoid fungi. Thirty-three species are new records for Brazil and 50 are new for Minas Gerais state, some of which are interesting references for the Atlantic Rain Forest. According to Pegler (16) the agaric mycota of the Atlantic Rain Forest is similar to that found in the Caribbean, other regions in tropical America, and in the Lesser Antilles. The species, number of collections, substrate, national references, and locality are presented in Table 1.

Table 1. *Agaricales* taxa from two Atlantic Rain Forest fragments present in Minas Gerais state, Brazil. * First record from Minas Gerais state, ** First record from Brazil, N = number of collected specimens; G = ground, L = leaf, W = wood; EEco = Ecological Station of Universidade Federal of Minas Gerais; PERD = Rio Doce State Park.

Family/species	N	Substrates			Locality	
		G	L	W	EEco	PERD
Agaricaceae						
Agaricus cf. *brunneostictus* Heinem.**	1	x			x	
A. junquitensis Heinem.**	1	x				x
A. nigrescentulus Heinem.**	1	x			x	
A. parasilvaticus Heinem.*	1	x				x
A. purpurellus (F.H. Møller) F.H. Møller*	2	x			x	x
A. silvaticus Schaeff.*	1	x			x	
A. singeri Heinem.*	1	x			x	
A. trinitatensis R.E.D. Baker & W.T. Dale**	1	x			x	
A. cf. *violaceosquamulosus* R.E.D. Baker & W.T. Dale*	1	x			x	
Agaricus sp. 1	14	x			x	
Agaricus sp. 2	1	x				x
Lepiota cf. *marriagei* D.A. Reid**	1	x			x	
L. cf. *murinocapitata* Dennis*	1	x				x
L. cf. *phaeosticta* Morgan*	1			x	x	
L. cf. *tepeitensis* Murrill*	1	x			x	
L. epicharis Berk. & Broome*	2	x			x	
L. erinana Dennis**	1			x	x	
L. parvannulata (Lasch.) Gillet**	1			x		x

Family/species	N	Substrates			Locality	
		G	L	W	EECO	PERD
L. subamanitiformis Dennis**	1	x			x	
L. subalba Kühner ex P.D. Orton**	1			x		x
L. subclypeolaria (Berk. & M.A. Curt.) Sacc.*	1	x				x
L. cf. *subflavescens* Murrill*	1	x				x
Lepiota sp. 1	1	x				x
Lepiota sp. 2	1			x		x
Lepiota sp. 3	1	x				x
Leucoagaricus barssii (Zeller) Vellinga**	1	x				x
L. cf. *cinerascens* (Quél.) Bon & Boiffard**	3	x				x
L. fuligineus Pegler**	1	x			x	
L. rubrotinctus (Peck) Singer**	1	x				x
L. wychanskyi (Pilát) Bon & Boiffard**	4	x			x	x
Leucoagaricus sp.	1			x	x	
Leucocoprinus brunnescens (Peck) Locq.*	1	x				x
L. cf. *longistriatus* (Peck) H.V. Smith & N.S. Weber*	2	x				x
L. sulphurellus Pegler*	1	x				x
L. tenellus (Boud.) Locq.**	1	x				x
L. venezuelanus Dennis*	3	x				x
Leucocoprinus sp. 1	3	x				x
Leucocoprinus sp. 2	1			x		x
Leucocoprinus sp. 3	2	x				x
Leucocoprinus sp. 4	1	x			x	
Leucocoprinus sp. 5	1	x				x
Macrolepiota bonaerensis (Speg.) Singer*	1	x				x
M. mastoidea (Fr.) Singer*	2	x			x	
Macrolepiota sp.	1	x			x	
Rugosospora pseudorubiginosa (Cifuentes & Guzmán) Guzmán & Bandala*	1			x		x
Coprinaceae						
Coprinus pseudomicaceus Dennis**	1			x		x
Panaeolus campanulatus (L.) Quél.*	2	x			x	
P. cf. *fraxinophilus* A. H. Sm.**	1			x		x
P. pygmaea (Bull.) Singer*	1	x				x
Parasola plicatilis (Curt.: Fr.) Redhead, Vilgalys & Hopple*	1			x		x
Psathyrella araguana Dennis**	3			x		x
Cortinariaceae						
Gymnopilus dryophilus Murrill**	1			x		x
G. johnstonii (Murrill) A.W. Wilson, Desjardin & E. Horak*	1		x		x	
*G. neotropicus (Singer) J.L. Mata**	6	x			x	x
*G. omphalodes (Berk.) Halling & J.L. Mata**	2			x	x	x
Gymnopilus sp.	1			x		x
*Pyrrhoglossum cf. holocrocinum (Berk.) Singer***	1			x		x
Crepidotaceae						
*Tubaria cf. dispersa (L.) Singer***	3			x		x
Entolomataceae						
*Inopilus cystidiophorus (Dennis) Pegler**	2	x			x	
*I. speciosus (Romagn.) Pegler**	1	x			x	
Inopilus sp.	1	x			x	
*Nolanea metalis (Romagn.) Dennis***	1		x		x	
*N. sipariana (Dennis) Dennis***	1	x			x	
Hygrophoraceae						
*Hygroaster nodulisporus (Dennis) Singer**	2	x			x	
Hygrocybe sp.	1	x			x	

Family/species	N	Substrates			Locality	
		G	L	W	EECO	PERD
Pluteaceae						
Pluteus cubensis (Murrill) Dennis*	1			x		x
P. harrisii Murrill*	2			x		x
P. haywardii Singer*	1			x		x
P. umbrinoalbidus Singer*	1			x		x
Pluteus sp.	2			x		x
Volvariella earlei (Murrill) Shaffer**	1	x			x	
Volvariella sp.	1			x		x
Tricholomataceae						
Anthracophyllum andinum Dennis**	1			x		x
Baeospora sp.	1			x	x	
Collybia bakeri Dennis*	1			x	x	
C. coracicolor (Berk. & M.A. Curtis) Dennis*	1			x	x	
Crinipellis bisulcata (Pat. & Gaill.) Pat.**	1			x		x
C. eggersii Pat.**	1			x	x	
C. cf. *septotricha* Singer**	1	x				x
Cyptotrama asprata (Berk.) Redhead & Ginns*	4			x	x	
Dactylosporina steffenii (Rick) Dörfelt*	1	x			x	
Hydropus sphaerospora Dennis (Dennis)**	1			x		x
Lactocollybia epia (Berk & Broome) Pegler*	13			x	x	x
Lepista subisabellina (Murrill) Pegler**	1	x				x
Leucopaxillus gracillimus Singer & A.H. Sm.*	1			x	x	x
Marasmiellus paspali (Petch) Singer**	1			x		x
Marasmius allocystis Singer**	2			x	x	
M. bellus Berk.*	2			x	x	
M. dennisii Singer*	2			x	x	
M. ferrugineus (Berk.) Berk. & M.A. Curtis	3			x	x	
M. floriceps Berk. & M.A. Curtis*	1			x		x
Marasmius cf. *graminum* (Lib.) Berk.*	1		x			x
M. haematocephalus (Mont.) Fr.*	1		x		x	
M. helvolus Berk.*	1			x		x
M. leoninus Berk.*	7			x	x	x
M. phaeus Berk. & M.A. Curtis*	1			x	x	
M. podocarpi Desjardin & E. Horak	1			x		x
M. niveus Mont.*	3			x	x	
M. rhyssophyllus Mont. ex Berk. & M.A. Curtis**	1			x		x
Marasmius sp. 1	2			x		x
Marasmius sp. 2	1			x	x	
Marasmius sp. 3	1			x	x	
Mycena holoporphyra (Berk. & M.A. Curtis) Singer*	1	x			x	
Nothopanus eugrammus (Mont.) Singer (sensu Pegler 1983)*	3			x	x	x
Oudemansiella canarii (Jungh.) Höhn.*	2			x		x
Tetrapyrgos nigripes (Schwein.) E. Horak*	1			x	x	
Tricholomopsis sp.	2			x		x
Trogia cantharelloides (Mont.) Pat.	1			x		x
Xeromphalina tenuipes (Schwein.) A.H. Sm.	4			x		x

The families in order of the highest number of species were *Agaricaceae* (41.3%) and *Tricholomataceae* (36.7%), followed by *Pluteaceae* (6.4%), *Coprinaceae* (5.5%), *Entolomataceae* (4.6%), *Cortinariaceae* (2.8%), *Hygrophoraceae* (1.8%), and *Crepidotaceae* (0.95%). In the family *Agaricaceae*, *Lepiota* was the genus with the largest number of species collected [with 14 specimens], followed by *Agaricus* [11], *Leucocoprinus* [10], *Leucoagaricus* [6],

Macrolepiota [3], and *Rugosospora* [1].

Agaricus sp. 1 was the taxon with the highest number of collections [14] and it is possibly a new species, although more investigation is needed to name it. *Leucocoprinus* needs further study, especially considering that five species remained unidentified in this work. According to molecular studies, which are very important tools in elucidating relationships among species within this genus (29, 30), *Leucoagaricus* forms a monophyletic clade. Members of the *Agaricaceae* are distributed worldwide with many representatives in tropical and temperate regions, and a few species in artic-alpine areas and in deserts. However, the number of taxa and the species composition differ considerably by region (30).

In the family *Tricholomataceae*, 16 of the collected species belong to *Marasmius*, and 13 collections of *Lactocollybia epia* were found. *Marasmius* is important in decaying leaves and twigs in the litter of forests. *Marasmius* represent approximately 500 species and frequently found in tropical regions (5, 10) with ca. 115 species mentioned for Brazil (6, 16, 18, 19), excluding the new citations presented herein. The most common species in this genus was *M. leoninus*, which was described from Amazonas state (2) and is also known from the states of Rio Grande do Sul (26), São Paulo (16), and Paraná (12). *L. epia* has been reported in Pernambuco (25, 4), São Paulo (16), and Paraná (12).

Tricholomataceae sensu Singer (27) is a very a diverse family of *Agaricales* and represents a significant component of the mycobiota of temperate and tropical areas. Several taxonomic studies have showed that *Tricholomataceae* and *Agaricaceae* are dominant in tropical forests (4, 16). Some of the most common species of *Tricholomataceae* collected in this work are *Cyptotrama asprata*, previously mentioned for Paraná state (12) and Rio Grande do Sul (28), *Gymnopus neotropicus*, mentioned for São Paulo state as *Collybia neotropica* (16, 17), and *Xeromphalina tenuipes* of which synonym has two types collected in Brazil, viz. *Agaricus rheicolor* Berk. described from Minas Gerais [= *Micromphale rheicolor* (Berk.) Dennis)] and *A. citriceps* Mont. described from Espírito santo state. This species is also known from the states of Rio Grande do Sul [Rick (20) as *Collybia rheicolor* (Berk.) Sacc.], São Paulo (16), and Paraná (12). The remaining families are represented by fewer species. However, this does not imply that they are infrequent in the studied areas, but only that more frequent collection trips to the sites are necessary to improve the collections.

All of the collected and identified species in this study were grouped in three classes of substrates: soil, leaves, and wood. The majority of species collected were found growing on wood and soil. Only four species were collected on dead leaves (Table 1). Knowledge of the distribution, dynamics and activities of *Agaricales* is crucial to understanding how can influence and modify the soil and the organic matter present in the tropical environments.

Much more extensive observation, sampling, recording, inventory taking, and analysis will be necessary to understand the ecological role of *Agaricales* in tropical ecosystems. The broad diversity and taxonomic spectrum exhibited by these fungi make them especially interesting for taxonomic and ecological studies as well as biotechnological screening programs. Thus, more research is required to increase our knowledge for conservation planning on *Agaricales* in Brazilian tropical ecosystems.

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