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Hitherto unreported *Agaricus* species of Central India

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Abstract. *Karwa A, Rai MK. 2010. Hitherto unreported* Agaricus *species of Central India. Nusantara Bioscience 2: 141-145.* Melghat forest region from Central India was surveyed for occurrence of medicinal and culinary mushrooms during the years 2005-2008. Out of total 153 species, ten species of *Agaricus* were recorded from different localities. Of these, seven species namely *Agaricus bitorquis, A. subrufescens, A. augustus, A. placomyces, A. essettei, A. basioanolosus* and *Agaricus* sp. nov (a new species) are being reported for the first time from the region. The commercial button mushroom *Agaricus bisporus* lacks good breeding characters due to its bisporic nature. These wild cousins of the button mushroom can definitely prove to be a good source of genetic manipulations to the existing strains and also to develop new strains with improved characters.

Key words: *Agaricus*, Central India, commercial, edible, Melghat.

Abstrak. *Karwa A, Rai MK. 2010. Spesies* Agaricus *dari India Tengah yang belum dilaporkan sampai sekarang. Nusantara Bioscience 2: 141-145.* Kawasan hutan Melghat di India Tengah disurvei untuk mengetahui keberadaan jamur yang berkhasiat obat dan kuliner selama tahun 2005-2008. Dari total 153 spesies jamur, sepuluh spesies *Agaricus* ditemukan di berbagai lokasi yang berbeda. Dari jumlah tersebut, tujuh spesies yaitu *Agaricus bitorquis, A. subrufescens, A. augustus, A. placomyces, A. essettei, A. basioanolosus* dan *Agaricus* sp. nov. (spesies baru) baru pertama kali dilaporkan keberadaannya di kawasan ini. Jamur komersial *Agaricus bisporus* tidak memiliki karakter perkembangbiakan yang baik karena secara alamiah bersifat bispora. Kerabat liar dari jamur ini dapat digunakan sebagai sumber manipulasi genetik pada strain yang ada dan juga untuk mengembangkan strain baru dengan karakter yang lebih baik.

Kata kunci: *Agaricus*, India Tengah, komersial, dimakan, Melghat.

INTRODUCTION

Agaricus bisporus (J.E. Lange) Imbach (Agaricaceae) commonly known as commercial white button mushroom is the most extensively cultivated mushroom worldwide and comprises about 32% of world mushroom production. However, modern approaches to breeding this economically important fungus have been largely ignored. The previous attempts for genetic improvements in this commercially important mushroom has little success due to low genetic diversity amongst commercially cultivated white strains and non-inclusion of wild collections in the breeding programs. Thus, limited availability of genetic variation significantly slowed down the progress of genetic improvement in this strain of commercially important button mushroom (Hawksworth 1991; Singer 1989). On the other hand, there is a plethora of wild species in the genus *Agaricus* in many Indian forests. Many of them are collected and consumed by the local people, mostly by the tribes. There is a great need to bring into cultivation the other possible wild isolates of this much-preferred genus. The new species entering the commercial market can promise an improved productivity, shelf life and quality as compared to the currently cultivated button mushroom. Collection of wild germplasm of *Agaricus* is the first phase for initiating the breeding program.

India being the 6th mega spot of biodiversity has innumerable mushroom species and their ethnomycological importance. One third of fungal diversity of the globe exists in India (Butler *et al.* 1960, Bilgrami *et al.* 1981; Sarbhoy et al. 1996; Doshi and Sharma 1997; Manoharachary 2001; Maria and Sridhar 2002; Manoharachary *et al.* 2005). Melghat is a Reservation Forest for tigers in Amravati District, Maharashtra State, India. The biodiversity of this region is unique due to its varying biogeographical and physicochemical environment. This region has intermingling forests of highly valuable and endangered medicinal plants, as well as a variety of edible and medicinal mushrooms few of which are consumed by local tribes. Biodiversity of edible fungi has been reported from different parts of India by several workers but this region remained unexplored and the fungal treasure of the region yet unnoticed by eminent mycologists of the country.

The aim of the present study was to explore the region for the existence of the valuable and neutriceutically important wild mushrooms and their conservation. Six different zones in the region were surveyed from July 2005 to December 2008 for the availability of wild edible and medicinal mushrooms. In this paper we report a total of 10 wild species of *Agaricus* of which seven species are hitherto unreported.

MATERIAL AND METHODS

Ten species of wild *Agaricus* mushrooms were collected from different localities in Melghat region of Central India in Amravati District, Maharashtra State (Figure 1) during 2005 to 2008. Repeated visits and periodical surveys of the localities revealed a plethora of wild mushrooms out of which the genus *Agaricus* seemed to spring out in all the localities throughout the monsoons (June to September). Mushrooms were collected from the non reserved region of the forest like roadsides, landscapes, grasslands, pastures. Mushrooms were digitally photographed using a Sony DSC R1 Professional Camera. The collected specimens were brought to the lab, cleaned, and microscopical examinations of the hymenium, basidiospores, and cuticle were performed. Taxonomic identifications were made based on their morphological, microscopic and staining studies according to the methods given by Brietenbach and Kranzlin (1991) and Phillips (1991, 2006).

RESULTS AND DISCUSSION

Results

During the present study, a total of 153 species of mushrooms were identified and keyed to 47 genera belonging to 26 families. Of these, species of the genus *Agaricus* were found to be more abundant compared to other collected mushroom species. Table 1 illustrates a list of the wild *Agaricus* mushrooms that are identified till date. After interaction with local people and the tribals inhabiting the region we came to know that though some of these species of *Agaricus* are eaten in some or the other parts of the world, they are not utilized here for food. The wild *Agaricus* mushrooms (Figure 2) and their description is as follows:

Agaricus bisporus Lange

Found scattered on pastures, lawns and on scattered manure. Pileus: 5-10 cm diameter, convex in young, flattened in old fruit bodies. White to pale-brown, finely scaly surface, margin entire. Gills: prominent, crowded, free, white in young, pink to dark brown to blackish in older ones. Stipe: central, equal, 4-10 cm long, 1-2 cm thick, white to pale brown, annulate, annulus white membranous prominent. Basidia: 2 spored, spores brown, ellipsoid, 7x5.5 μm^2. Spore print: sepia to brown.

Agaricus bitorquis (Quel.) Sacc.

Found solitary as well as in groups on roadside and soil rich in manure. Pileus: 10.5 cm in diameter, convex in young, plane in old fruit bodies. Yellow to brownish towards center with a small depression in center. Gills: white in young, pink to brown to blackish in old, crowded, free, broad. Stipe: 5-7 cm long, 2 cm thick, white, thick annulus in middle of stipe. Basidia: 4 spored, spores brownish purple, ellipsoid, 7.5x6 μm^2. Spore print: dark brown.

Agaricus arvensis Schaeff.

Found solitary or scattered and in fairy rings in grazing lands. Pileus: approximately 10 cm in diameter, convex in young, flattened in old, white smooth surface, light brown towards center. Gills: free, crowded, white in young, pink to chocolate brown in old, moderately broad. Stipe: thick, cylindrical, central, 8-10 cm long, white, hollow, large annulus. Basidia: squat, broad, 4 spored, spores small and brown, oval 6x4 μm^2. Both pileus and stipe bruises yellow on handling.

Agaricus augustus Fr.

Found solitary or scattered in grazing lands and gardens. Pileus: sub-globose in young and convex to flat in old, 3-7 cm in diameter, yellow-beige coloured smooth surface, reddish towards center. Gills: white in young, pink in old, narrow, free crowded. Stipe: thick, smooth, cylindrical, 5 -10 cm long, cream coloured, hollow, annulus thin, close to pileus. Basidia: broad, 4 spored, spores: light brown, oval 4x6 μm^2.

Agaricus essettei Bon

Found solitary as well as in tufts in grasslands and forest. Pileus: light to dark brown, 3-8 cm in diameter, surface scaly with dark brown center, sub-globose when young and expanded rounded when old. Gills: pink to brown with age, narrow to moderately broad, crowded, free. Stipe: thick, cylindrical, stuffed, bulbous base, light brown, scaly, annulate. Basidia: 4 spored, spores brown, subelliptical 4x5.5 μm^2. Both pileus and stipe bruise yellow with handling.

Agaricus silvaticus Schaeff.

Found solitary in bushy and grassy places. Pileus: 6-10 cm in diameter, cream to perfect beige coloured, convex when young, expanded and gibbous in old. Surface fibrillose. Gills: crowded, free, moderately broad, red to narrow towards apex, hollow, annulus thin ring. Basidia: 4 spored, spores small, globose, 2.5x2.8 μm^2, brown.

Table 1. Species of the genus Agaricus collected from Melghat region of Central India.

Accession number	Name of the mushroom	Period of collection	Population
MGCC 98	*Agaricus arvensis*	July 2005-August 2008	Abundant
MGCC 62	*Agaricus augustus*	July 2005-August 2008	Moderate
MGCC 03	*Agaricus bitorquis*	July2005-September 2008	Moderate
MGCC 07	*Agaricus bisporus*	July2005-September 2008	Abundant
MGCC 77	*Agaricus essettei*	June 2005-July 2008	Rare
MGCC 37	*Agaricus placomyces*	June2005-July 2008	Rare
MGCC 63	*Agaricus silvaticus*	Aug2005-September 2008	Moderate
MGCC 136	*Agaricus silvicola*	July2005-September 2008	Rare
MGCC 33	*Agaricus* sp.nov.	June2005-Aug	Moderate
MGCC 55	*Agaricus subrufescens*	Aug2005-August 2008	Moderate

MGCC = Mushroom germplasm culture collection.

Agaricus silvicola (Vittad.)

Found solitary or in tufts in shady places of the forest. Pileus: 6-10 cm in diameter, convex in young, expanded to nearly plane in old, white, smooth, with distinct umbo. Gills, crowded, white to pink to dark brown with age, broad. Stipe: 6-10 cm long, cylindrical, uniform, white, slightly bulbous base, white prominent annulus. Basidia: 4 spored, spores brown, elliptical, 5x6.5 µm^2.

Agaricus sp. nov.

Found solitary in grasslands and forest. Pileus: 5-9 cm in diameter, light brown surface covered with dark brown scales throughout, dense at center, conical to convex in young, more expanded convex in old. Gills pink to brown to black with age, not auto deliquescent, broad. Stipe: 5-9 cm long, light brown, less scaly, equal, cylindrical, stuffed, light brown annulus. Basidia: 4 spored, spores brown, spherical 5x5 µm^2.

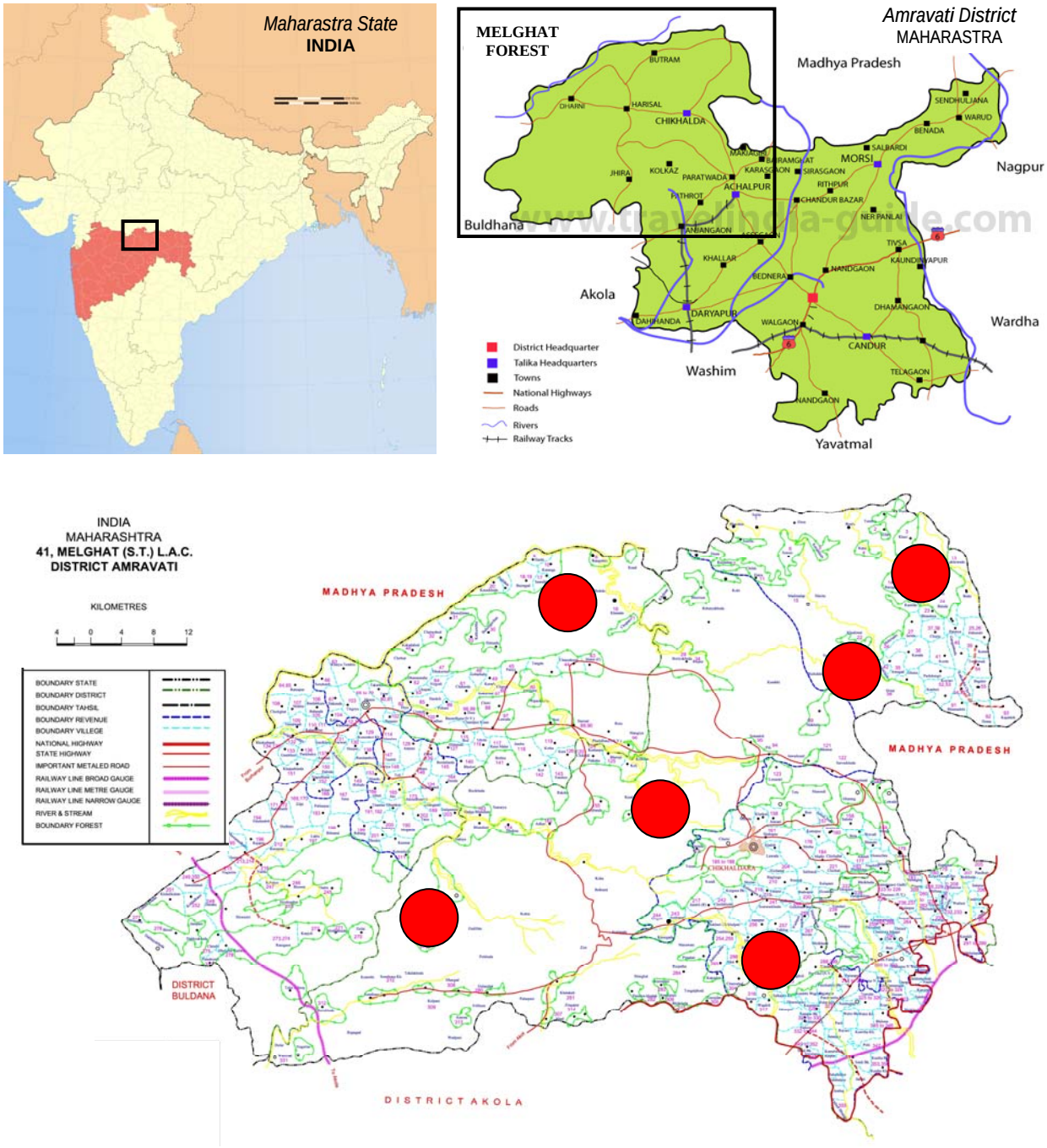

Figure 2. Locations of mushroom collection (highlighted in circle) in Melghat forest, Amravati District, State of Maharastra, India

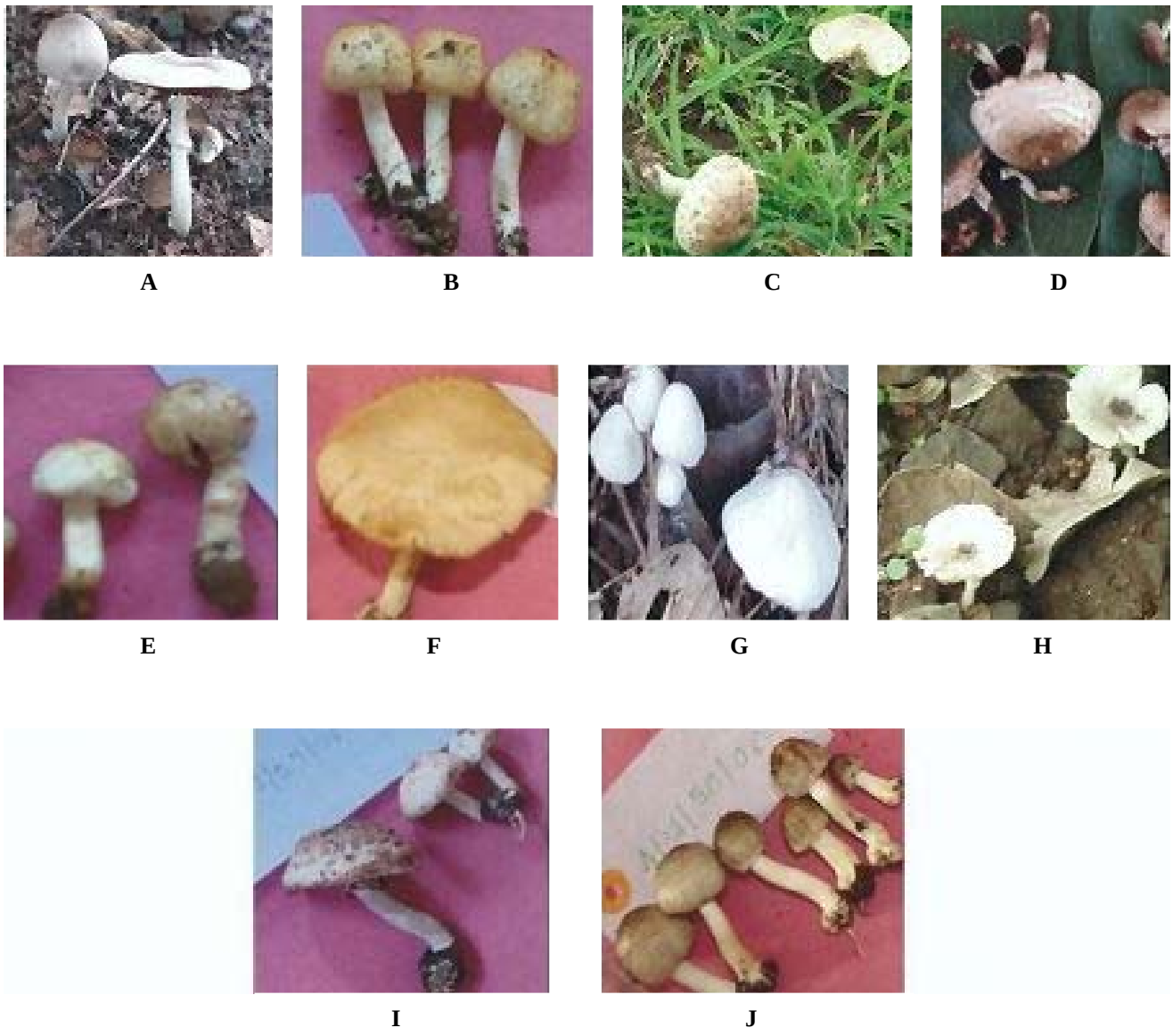

Figure 3. Plates of ten different *Agaricus* species collected from wild in Central India. Note: A. *Agaricus arvensis,* B. *Agaricus augustus,* C. *Agaricus bitorquis,* D. *Agaricus bisporus,* E. *Agaricus essettei,* F. *Agaricus silvaticus,* G. *Agaricus silvicola,* H. *Agaricus placomyces,* I. *Agaricus* sp.nov. J. *Agaricus subrufescens.*

Agaricus subrufescens Peck.

Found in tufts on ground or lawns or pastures in shades. Pileus: 3-10 cm in diameter, hemispherical to somewhat conical when young, convex to broadly expanded old, light yellow to brown surface with brown scales. Gills: crowded, free, white to chocolate brown with age, narrow. Stipe: 10-15 cm long, hollow, white, annulated, shiny, swollen base. Basidia: 2-3 spored, spores dark brown elliptical, 6x3.5 μm^2. Found solitary or scattered in grazing lands and gardens. Pileus: subglobose in young and convex to flat in old, 3-7 cm in diameter, yellow-beige coloured smooth surface, reddish towards center. Gills: white in young, pink in old, narrow, free crowded. Stipe: thick, smooth, cylindrical, 5 -10 cm long, cream coloured, hollow, annulus thin, close to pileus. Basidia: broad, 4 spored, spores: light brown, oval 4x6 μm^2. Dark brown. Stipe: 7-12 cm long, cylindrical, slightly

Agaricus placomyces Peck.

Found solitary and scattered on soil. Pileus: 10 cm in diameter, ovate when young, convex to plane in old, white with dark brown center, brown scales. Gills: not crowded, free, white to pink to dark brown with age. Stipe: 7-10 cm long, cylindrical, stuffed, white to pale brown, tapering towards apex, large white annulus towards pileus. Basidia: 4 spored. Spores brown, ellipsoid, 5x3 μm^2, spore print brown.

Discussion

Though India has rich macro fungal biodiversity, most traditional knowledge about mushrooms come from the Far East countries like China, Japan, Korea, and Russia where mushrooms like *Ganoderma, Lentinus, Grifola* and others were collected and used since time immemorial. Most of

the mushrooms grow abundantly in nature and their commercial harvest is being undertaken for the benefit in these countries. Therefore, systematics of wild mushrooms has received more attention than other threatened aspects like conservation. However, the ecological data available on some of the genera is still not enough.

Besides extensive surveys and records from Punjab, Kerala and Western Ghats published during the last decade (Pradeep et al. 1998; Atri et al. 2000). In his book Purkayastha described identification of wild Indian mushrooms (Purkayastha and Chandra, 1985). Lakhanpal (1996, 1997) and his students from India extensively surveyed the Himalayan ranges during 1980's to 1990's and reported a wide range of wild mushrooms including some highly medicinal species. What is noteworthy is the component of macro fungi that dominates the Central India, and the Genus *Agaricus* in particular, that has been neglected.

Guzman (1983) of Mexico reported many wild edible and medicinal mushrooms along with *Psilocybins* (1983). Wasser et al. (2004) and Chang and Buswell (2003) studied nutraceutical and therapeutic properties of wild mushrooms including *Agaricus*. Stamets (2000) is the sole name in USA since the last 3 decades who is dedicated to study wild mushrooms and their applications in various fields of medicine as well as societal and ecological development.

However, research on wild mushrooms in Central India has been greatly neglected by mycologists. Here we summarize that there is an urgent need to explore the Central Indian forests and other regions so that a complete inventory of wild mushrooms can be developed and conservation of the important species can be sought for. Out of the wild species of *Agaricus* mentioned in this paper, seven species namely *Agaricus bitorquis, A. subrufescens, A. augustus, A. placomyces, A. essettei, A. basioanolosus* and *Agaricus* sp. nov. are being reported for the first time from the region and are promising sources for genetic improvement of the available commercial white button mushroom.

CONCLUSION

Out of total 153 species mushroom in Melghat forest, ten species of *Agaricus* were recorded from different localities. Of these, seven species namely *Agaricus bitorquis, A. subrufescens, A. augustus, A. placomyces, A. essettei, A. basioanolosus* and *Agaricus* sp. nov. (a new species) are being reported for the first time from the region. These wild *Agaricus* can definitely prove to be a good source of genetic manipulations to the existing strains of the commercial button mushroom *Agaricus bisporus* and also to develop new strains with improved characters.

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