Advances in Bioresearch
Volume 3 [2] June 2012: 119 - 123
ISSN 0976 – 4585

www.soeagra.com/abr/abr.htm

ORIGINAL ARTICLE

Fungal Diversity of Mandeepkhol Cave in Chhattisgarh, India

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ABSTRACT
Fungi are an important microflora found in well diversified ecological condition including cave. In Chhattisgarh state of India one beautiful cave is found in mountain range of Salewara nearly 100 k.m. away from Durg district. The cave is multi channel with temperature range 26ºC- 28ºC, humidity 80- 90% and with complete dark zone beside twilight zone. The floral and faunal diversity of cave is a matter of interest. Present paper deals with the fungal diversity of the cave with 54 reported species. Out of total reported species, 4 species (3 genera) belong to Zygomycotina, 2 species (2 genera) belong to Ascomycotina and 48 species (12 genera) belong to Deuteromycotina. Maximum numbers of species were isolated from guano deposits followed by leaf litter and log and twig deposits.

INTRODUCTION

Caves are divided into different zones based on the prevailing light and temperature [1]. According to Poulson and White, each cave has three zones: (i) twilight zone which is located at the entrance area; (ii) middle zone in which relative darkness prevails with fluctuating temperature; and (iii) dark zone in which total darkness and constant temperature prevails [2, 3]. It has been observed that there is an increased interest in cave microbiology since last few years. The study of cave microbiology deals with the microscopic creatures/ organisms that are inhabitants of caves. The science of cave microbiology has similarly mirrored the meteoric rise of microbiology as a science with a new insight suggesting that cave microorganisms may be involved in processes as varied as speleothem deposition to cavern enlargement [4, 5].

There are many important roles of cave microorganisms. Microorganisms play a crucial role in maintaining the delicate ecological balance of the earth. They help in recycling of organic matters. They are helpful in preservation of ancient marble monuments and statues, where microorganisms could be used to deposit a veneer of calcite to protect ancient structures from continued erosion [6].

Fungi are remarkable for their antiquity, diversity, ubiquitous distribution and longevity [7]. Fungi are known to occur in almost all environments including caves [8]. Fungi play important role in breakdown of complex aromatic compound like benzothiazole and benzene sulfonic acid which are dangerous for environment. With help of these microbes such pollutants can be removed thereby restoration of natural habit can be maintained. Certain specific species of fungi are the engines of the process of decomposition, essential for natural recycling, helping to guarantee life on earth. In nature biodegradation is mainly carried out by thermophilic bacteria, actinomycetes and fungi in anerobic microenvironment. Fungi play an important role in biodegradation as they break down tough organic materials like lignin and cellulose enabling bacteria to continue the decomposition process once most of the cellulose and lignin have been exhausted. Fungi are dominant decomposers and nutrient recyclers of forest litter and debris. Without decomposer fungi we would soon be buried in debris. The aim of this paper is to find out the diversity of fungi from Mandeepkhol cave which is a Dark cave with a constant temperature around 26^0C- 28^0C.

METHODOLOGY

Description of cave

Mandeepkhol cave is located in the mountain range of Salewara near copper mines Malajkhand in M.P. It is nearly 100 kilometres from district Durg and 130 kms from Raipur in Chhattisgarh. The cave is located in deep forest and is not easily approachable. It is about 30 kms from nearest township of Gandai. The cave is basically an adit cave that has a narrow entrance. The twilight zone

of the cave is hardly 2-3 meters and the remaining part is completely dark. The temperature of that cave remains constant between 26-28ºC throughout the year. Entrance is connected to mountain valleys. During rainy season a huge amount of water in form of stream flow in these valleys enters into the cave through these narrow entrances and brings twigs, logs and lot of dried leaves inside the cave and deposits there. Inside of the cave numbers of large branched tunnels are commonly found. Some of the tunnels end blind whereas some are so long that their termini could not be traced. Inside cave at certain places small to large ditches have been formed where water get collected and are responsible for high humidity and water continuously leaching down from roofs and side walls. The Mandeepkhol cave provides shelter to large number of bats which hang from the roofs. The excreta of these bats get deposited over the floor in a very large quantity that contains high percentage of cellulose and lignin.

Isolation of fungi

Samples for fungal isolates were collected from the Cave during summer season in the month of May and guano deposits, log and twig deposits, leaf litters separately were collected aseptically in polythene bags.

The isolation of microscopic fungi was done using potato dextrose agar media. The samples were serially diluted by method of serial dilution. Dilution of 10^{-3}, 10^{-4}, 10^{-5} were taken. Few drops of samples were poured into petriplates containing potato dextrose agar media using micropipette. The petriplates were kept for incubation in incubator for 28ºC ± 2ºC. After incubation fungal colonies were counted and identified. Identification of fungi was done by analyzing both morphological and microscopic characters and further by help of available literature.

RESULTS AND DISCUSSIONS

A total of 54 species belonging to 16 genera and two sterile mycelia were isolated. Among them *Deuteromycotina* fungi dominated over the member of *Ascomycotina* and *Zygomycotina*. Out of total isolates 4 species (3 genera) belong to *Zygomycotina*, 2 species (2 genera) belong to *Ascomycotina* and 48 species (12 genera) belong to *Deuteromycotina*. (Table-1).

In the cave *Aspergillus* taxa were found dominant. The genus *Aspergillus* were represented by 16 species, *Penicillium* was represented by 10 species, *Curvularia* by 4 species, *Fusarium* and *Cladosporium* by 3 species, *Alternaria, Dreshclera*, *Rhizopus*, *Trichoderma* by 2 species and *Periconia, Monilia, Mucor, Choenophora cucurbatarum, Emercilla nidulans, Phanerochaete chrysosporium, Talaromyces flavus* represented by one species.

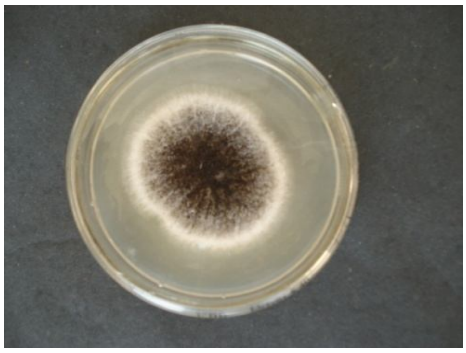
From among different resources maximum diversity was found from guano deposits (29 species from 65 colonies) followed by leaf litter deposits (25 species from 62 colonies) and logs and twigs deposits (22 species from 61 colonies). Similar work has been reported by Koilraj and his co-workers [9] where they studied fungal diversity inside caves of southern India. They had isolated thirty-five species of sporulating mesophilous fungi and seven types of non-sporulating fungi from the soil samples collected at the entrance, twilight and dark zones of six caves. Novakova [10] also studied diversity of fungi from Domica cave system where they have isolated total of 195 fungal taxa from various cave substrates. Similarly diversity of thermophilous soil microfungi in forest and cave ecosystems of Taiwan has also been studied by Hsu and coworkers [11].

Table 1- The Fungal diversity from different resource of Mandeepkhol cave of Chhattisgarh, India

Fungi reported from cave	**Guano Deposit**	**Leaf Litter deposit**	**Wood deposit**
Zygomycotina	**Colony number**	**Colony number**	**Colony number**
Choenophora Cucurbitarum		1	
Mucor hemalis	2		
Rhizopus oryzae			1
Rhizopus stolonifer			1
Ascomycotina			
Emercilla nidulans		1	1

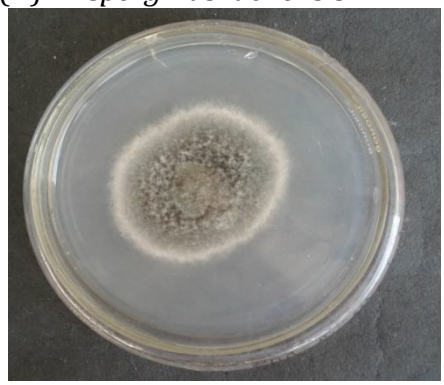
Talaromyces flavus		2	
Deuteromycotina			
Alternaria alternata	2	1	4
Alternaria crassa			1
Aspergillus albus	2		
Aspergillus astus	4		
Aspergillus aureus	2		
Aspergillus awamoori	1		
Aspergillus flavus	1		
Aspergillus fumigatus	2		2
Aspergillus japonicus	3		
Aspergillus luchensis	2	1	
Aspergillus nidulans	5		
Aspergillus niger	2	4	2
Aspergillus parasiticus	4	2	
Aspergillus sulphureus	1	1	
Aspergillus sydowii	2		
Aspergillus terreus	1		1
Aspergillus versicolor	3	2	
Aspergillus sp I			2
Cladosporium cladosporides		3	14
Cladosporium oxysporium		2	9
Cladosporium-sphaerospermum		10	
Curvularia clavata		4	5
Curvularia geniculata		2	2
Curvularia pallecense		2	
Curvularia lunata		1	1
Drechslera bicolor	4		
Drechslera tetramer	1		
Fusarium oxysporum		1	
Fusarium moniliform			1
Fusarium caucasicum	2		
Monilia sp		1	
Penicillium brevicompactum	2	4	1
Penicillium citrinum	5	2	3
Penicillium crysogenum			2
Penicillium digitatum		2	
Penicillium meleagranum var. viridiflavum	1	3	

Penicillium multicolor		1	1
Penicillium notatum	2	3	
Penicillium oryzae	2		2
Penicillium rubrum	3		
Penicillium rugulosum	1	2	
Periconia sp	1		
Phanerochaete chrysosporium			2
Trichoderma viridae	1		
Trichoderma atroviridae		1	
Mycelia sterilia			
Mycelia sterilia (White)			4
Mycelia sterilia (Peach)		3	



(A) *Aspergillus luchensis*

(B) *Aspergillus flavus*

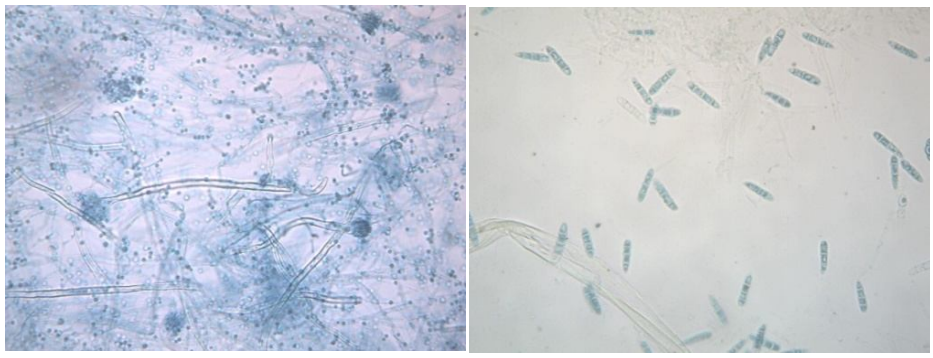


(C) *Alternaria crassa*

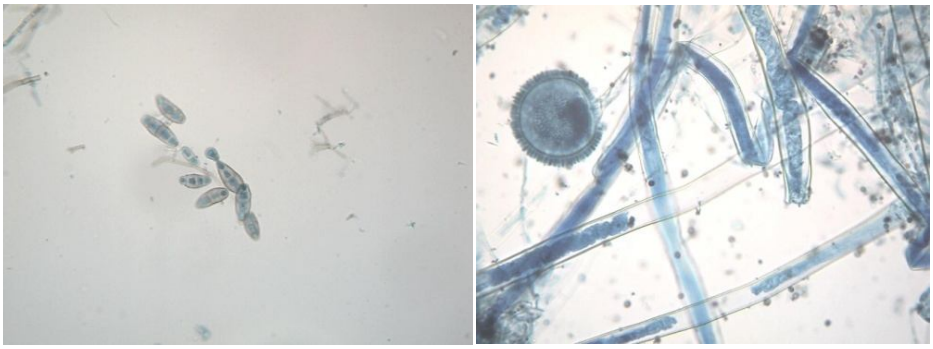
(D*) Curvularia oryzae*

(E*) Fusarium caucasicum*

(F) *Alternaria crassa*



(G) *Aspergillus flavus* (H) *Fusarium caucasicum*



(I) *Curvularia oryzae* (J) *Aspergillus luchensis*

Figure 1- Some of fungal isolates reported from Mandeepkhol cave

CONCLUSION

The result revealed that guano of bat are mostly preferred by some members of *Deuteromycotina* and *Zygomycotina* viz. species of *Aspergillus*, *Penicillium* and *Mucor*. It may be due to higher percentage of partially digested cellulose, lignin and pectin. The alimentary canal of bat provide shelter to various types of symbiotic and commensale bacteria which help in digesting the complex organic materials. On the other hand the members of *Deuteromycotina* viz *Alternaria*, *Cladosporium, Curvularia* preferred to grow over leaf litter and log and twig deposits that contain a greater percentage of lignin indicating that these mold species are lignophilic. It appears that *Cladosporium cladosporiodes* , *Cladosporium oxysporium* and *Curvularia clavata* are highly lignophilic and thus these mesophilic species may be useful for decomposition of litter and twig even.

REFERENCE

1. Mohr, C. E. and Poulson, T. L. (1996). *The Life of the Cave*. McGraw-Hill, New York.
2. Poulson, T. L. and White, W. B. (1969). The cave environment. *Science.* **165**: 971–981.
3. Koilraj, J. A. and Marimuthu, G. (1998). Algal flora in the cave soils *Curr.sci.* **75**: 1111–1113.
4. Canaveras, J.C., Cuezva, S., Sanchez-Moral, S., Lario, J., Laiz, L., Gonzalez, J.M., and Saiz-Jimenez, C. (2006). On the origin of fiber calcite crystals in moonmilk deposits. *Naturwissenschaften*, **93**: 27–32.
5. Engel, A.S., Stern, L.A., and Bennett, P.C., (2004), Microbial contributions to cave formation: New insights into sulfuric acid speleogenesis: *Geology.* **32**: 369–372.
6. Laiz, L., Pinar, G., Lubitz, W., and Saiz-Jimenez, C. (2003). Monitoring the colonization of monuments by bacteria: Cultivation versus molecular methods. *Environmental Microbiology*. **5**: 72–74.
7. Maheshwari, R. (1996). Special issue on genetics of filamentous fungi in honour of Perkins, David, D.: Preface. *J. Genet*. **75:** 239-243.
8. Semikolennykh A.A. (1997). Microorganisms in the caves of former –USSR: geography, ecology, geochemical activity .*In Proc. of 12th Int. Cong of Speleology*. **3**: 293-299.
9. Koilraj A. J, Marimuthu.G, · Natarajan. K, Saravanan. S, Maran.P, and Hsu.M.J. (1999). Fungal diversity inside caves of Southern India *curr. Sc.* 77: 1081- 1084.
10. Novakova A. (2009). Microscopic fungi isolated from the Domica Cave system (Slovak Karst National Park, Slovakia). *International Journal of Speleology*, 38(**1**): 71-82
11. Hsu, MJ. and Agoramoorthy, G. (2001). Occurrence and diversity of thermophilous soil microfungi in forest and cave ecosystems of Taiwan. *Fungal Diversity* 7: 27-33.