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Occurrence of keratinophilic fungi in coal mines soils of Korba, Chhattisgarh

S. PAHARE AND *R. V. SHUKLA
Department of Botany D. P. Vipra Post Graduate College Bilaspur, C.G.
Department of Botany, C. M. D. Post Graduate College Bilaspur, C.G. 495 001

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Soil samples collected from different localities of coal mining areas of Korba, Chhattisgarh which were examined for the prevalence of keratinophilic and other fungi colonizing keratinous substrate. The positive samples yielded twenty five isolates belonging to 17 species of 10 genera. The species of *Chrysosporium tropicum,* and *Microsporum fulvum C. indicum* have been frequently recovered along with the species of *Aspergillus, Fusarium, Humicola, Penicillium.* The Keralinophilic fungus *Microsporum fulvum, Trichophyton mentagrophytes* was obtained only from Deepika open cast mine.

Key words: Coal mines, Keratinophilic fungi, *Chrysosporium, Microsporum, Trychophyton*

INTRODUCTION

The keratinophilic fungi and their abundance in and around industrial waste is of special interest, because such habitats are expected for the richness of keratin remnants of human (mainly) and animal origin. This is a special group of fungi which play an important role in the decomposition of the keratin based solid waste (hairs, feathers, nails, horn, hooves etc.) to degrade in to components of low molecular weight. These fungi are the means of bioremediation and are being used as an important tool in biotechnology to minimize organic pollutants. There are several members of this group, which also parasitize keratinous tissue and display potentially pathogenic properties to animals, including human beings.

Most of the keratinophilic fungi viz. species of *Chrysosporium, Fusarium, Aspergillus, Curvularia* and *Alternaria* etc. are common saprophytes in soil and plant debris; which are also often recovered as laboratory contaminants. Many members of this group of fungi are reported from various habitats viz., public parks and soils / floor dust of primary school (Altras, 1967; Ramesh and Hilda, 1998-99), lake side soils (Ghosh and Bhatt, 2000), house dust (Nigam and Kushwaha, 1989), air samples (Della-Franca and Caretta, 1984), poultry farm (Deshmukh and Shukla, 2000-2001), birds and their environment (Dixit and Kushwaha, 1991), free living animals (Gugnani, 1970), sewage and sludge (Ulfig *et al.*, 1996, Awad and Kraume, 2011), and soil (Ali-Shtayeh *et al.*, 1988 1989; Jain, 1983; Garg,1966; Deshmukh *et al.*, 2000).

The coal mines area often remains contaminated with high inorganic and organic pollutants impacting the vegetational growth and livelihood of human populace. Since the coal is a biological non-functional material which can not sustain even the microbial population, therefore study on occurrence and distribution of keratinophilic fungi has been taken up from the coal mines of korba (Shukla and Agrawal, 1987). So far, the coal mines of Chhattisgarh, Central India has never been evaluted to explain the factor determining the qualitative and quantitive compositions of keratinophilic fungi.

*Department of Botany, C. M. D. College, Bilaspur, (C.G.)

The study on keratinophilic fungi in municipal and in industrial areas is essential due to hygienic and epidemiological importance. So far, the coal mining areas attracted less attention for providing data on the distribution of keratinophilic fungi. In coalmines there are igniting points derive from partly combusted coal deposits develop extreme environmental conditions providing opportunity to understand ecological relationship of microbial composition. The coal dust over coating land surface attributes water and nutrient deficient conditions in the habitat where lower and higher plants as well as microorganisms are poorly represented. Korba in Chhattisgarh is one of the largest industrial town of the country, which is well known for abundant of coal-mines and for maximum thermal power generating units of the government and public/private sectors. In present investigation an attempt has been made to examine keratinophilic and related soil fungi from the coal-mines soils nearer to Korba town.

MATERIALS AND METHODS

Korba is full of coal mines in area about 200 square miles. The mines are broadly classified into two categories i.e. underground and open cast mining. In present study the soil samples of various coal-mines were examined for the prevalence of keratinophilic fungi.

Collection of soil samples

A total of 100 soil samples were collected from the various mines of district Korba, between September to October (Table 1). The sample were collected from the superficial layer depth not exceeding 2" to 3" with the help of plastic spoon in sterilized polythene bags. The soil samples were collected from both the types of coalmines i.e. open cast- Deepika, Gevera, Kushmunda, Laxman, Manikpur and underground - Baqdeva, Balgi, Banki, Delvadih, Korba.

Isolation of fungi

Isolation were made following the 'Hair bait technique'. The sterilized petri dishes half filled with coal-mines soil moistened with 10 to 20 ml of sterilized distilled water. The defatted humun, hairs, nails and feathers of chicken were used as baits. The baits were buried in soil and plates were examined daily after 3 days for any sign of mycelial growth till four weeks, the fungi appearing on baits were isolated and purified on to Sabouraud's dextrose agar medium.

RESULTS AND DISSCUSSION

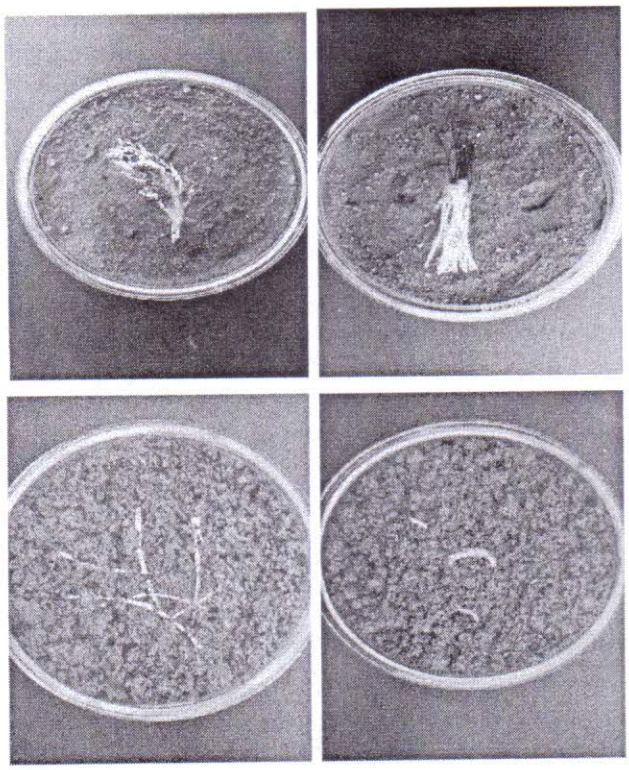
The results of the isolations are presented in Table 1 & 2. The data revealed that out of 100 samples (10 from each mine) 17 species of 10 genera were obtained. *Chrysosporium tropicum* was frequently isolated species. The other species of *Chrysosporium viz., C. indicum.* Various species of Chrysosporium have been reported from several mycologists in India (Nigam and Kushwaha 1989, Desmukh at al., 2000), Deshmukh and Shukla 2000-2001 reported from poultry farm soils of Bilaspur, Chhattisgarh.

Four unidentified species of *Aspergillus, Fusarium, Humicola, Penicillium* were also isolated. In addition to the above keratinophilic fungi, some species of soil inhabiting saprophytic fungi which appeared on baits buried in soil were also isolated. (Table 1). A total of 17 different species including 6 *Aspergillus,* 3 *Chrysosporium,* 2 species each of *Fusarium* and P*enecillium,* were isolated. The significance of the occurrence of these fungi in underground mines is not clear. Whether they are opportunistic and potential pathogens is debatable. However, *C. tropicum, C. zonatum* cause a disseminated infection (Desmukh et al., 2000).

Chrysosporium tropicum and C. indicum have been frequently recovered from soil which are known to have a worldwide distribution. Both the above fungi have been frequently recovered from soil samples of coal mines of Korba district. The species of *Chryposporium, Microsporum, and* many of *Aspergillus* have been found most frequently from all samples of underground mines. The second dominant dermatophyte showing keratinolytic activity is *Microsporum fulvum* recovered from most of the open coal-mines i.e. Deepika, Gevera, Laxman, Kushmunda, Manipur as well as from underground mines; Bagdeva, Balgi, Banki, Delvadeh, Korba. However, this fungus was absent from dusty polluted Manikpur mine nearer to Korba town.There are as many of keratinophilic fungi have been recovered only from fields with organic content. *Humicoala sp. Malbranchea aurantiaca, Trichophyton mentigrophytes* also recovered from the open coal mine soil.

Coal - fields soil allow the growth of a number of dermatophytes closely related to keratinophilic

fungi (Table. 1, Plate 1). The coal mines soils allow the growth of a number of keratinolphilc fungi and closely related dermatophytes. The soil samples studied were found positive results as most of the soil of different parts of the country examined were found positive to this group of fungi



(Kushwaha and Agrawal 1976, Ghos and bhatt 2000, Desmukh at al., 2000, Deshmukh and Shukla 2000-2001. Although it is difficult to differentiate the occurrence and distribution of keratinophilic fungi in both the underground and open cast mines environment as there are limitations of organic matter on which fungi grow and disseminate in neighbouring areas.

The occurrence of keratinophilic fungi in open cast mines is attributed to the higher influx from dead organic matter whether plant or animal group. In underground mines there are limitations of organic substrata where fungi grow matter. In underground mines there is limitation of organic matter even though keratinophilic fungi are quite frequent. However, there were many secondary sources of microbial contamination in their surroundings.

The moist and hot environment in narrow tunnels of underground mines seems more conducive for better growth of keratinophilic fungi. Even though, lesser number of fungi isolated from the samples of underground mines. This doesn't support the assumption that lesser number accounts for lesser chances of fungal invasion in mines workers. Because, the air circulating in closed circuit tunnels spreading enough fungal prop gules contamination causing considerable ratio of dermal infections among the mines workers. Moreover, the failure to isolate some of the common dermatophytes from underground mines might be due to either of their specific characterization in growth requirements as many of them prefers to grow on living animal hosts or due to lack of suitable techniques to detect and isolate these fungi from the tunnels environment.

During the investigation it has been observed that the open coal mines are the important sites for the isolation of keratinophilic fungi, where poor worker's particularly tribals population reside. The foot and finger's nails of poor mining workers have been often found damaged. There were many secondary sources of microbial contamination in open cast mines surroundings. However there are organic matter content keratinophilic fungi.

In open cast mines, there is no limitation of organic matter content keratin degrading ability of some of these isolates has also been tested were found keratinolytic in nature when grown on feathers containing mineral salt solution. Since many soil fungi do not confine themselves to a single mode of nutrition, but display a varying degree of flexibility and respond well to changes in their environment. The appearance of other soil inhabiting fungi on keratin baits during isolation may be because of above reasons. Further, their role in keratin obligation is important from the point of view of their potential application in kertain management.

The coal mines area are highly contaminated with coal and coal waste impacting the vegetational cover and the microbial populations (Shukla ; 1998). Since the coal is biological nonfuctional to sustain even the herbaceous growth, the area is highly contaminated in coal waste impacting the human livelyhood. The coal mines area high inorganic and organic pollutants have never been evaluated to explain the factors determining the qualitative and quantitative compositions of keratinophilic fungi.

The keratinophilic fungi in mining areas indicates not only the presence of keratin remnants and faecal contaminants but also respond to the changes

Table 1 : Isolation of keratinophilic fungi from different open coalmine soil of Korba, Bilaspur (C.G.)

No.	Name of the Fungi	01	02	03	04	05
1.	*Aspergillus fumigates*	+	+	+	+	+
2.	*A. niger*	+	+	-	+	+
3.	*A. nidulans*	+	+	+	+	+
4.	*A. terreus*	+	+	-	+	-
5.	*Aspergillus sp. -1*	-	+	+	-	-
6.	*Chrysosporium indicum*	+	+	+	+	+
7.	*C. lobatum*	-	-	-	-	-
8.	*C. tropicum*	+	+	+	+	-
9.	*Fusarium sp. I*	+	+	+	+	+
10.	*Humicola sp.I*	+	+	-	-	-
11.	*Malbranchea aurantiaca*	-	+	-	-	-
12.	*M. fulvum*	+	-	+	+	-
13.	*Paecilomyces sp.*	+	-	-	-	+
14.	*Penicillium sp. –I*	-	+	-	-	-
15.	*Trichophyton mentagrophytes*	+	-	-	-	-

(+ Present, - Absent), Numbers 1-5 represent open mines; 1-Deepika mine, 2- Gevera mine, 3- Kushmunda mine, 4- Laxman mine, 6- Manikpur mine.

Table 2 : Isolation of keratinophilic fungi from different under ground coalmine soil of Korba, Bilaspur (C.G.)

No.	Name of the Fungi	01	02	03	04	05
1.	*Aspergillus fumigates*	+	+	+	+	+
2.	*A. niger*	+	+	-	-	+
3.	*A. nidulans*	+	+	+	+	+
4.	*A. sp. II*	-	-	-	-	-
5.	*Chrysosporium. tropicum*	-	-	+	+	+
6.	*Fusarium oxysporium*	-	+	+	-	+
7.	*Microsporum fulvum*	+	+	+	-	+
8.	*Penicillium. sp.II*	-	-	-	-	-
9.	*Mucur sp.*	-	-	-	-	-

(+ Present, - Absent), Numbers 1-5 represent the mines; 1- Bagdeva mine, 2 -Balgi mine, 3- Banki mine, 4- Delvadih mine, 5- Korba mine.

in environmental conditions. These are multifunctional bio-indicator of environmental pollution. The fungal growth indices and their keratinolytic characterization would be an indication about their contamination and infection risk with potential fungal pathogens. Thus fungi obtained in mining areas may produce the great majority of fungal infections in man and animals, but they are not the only etiological agents in this process. It is assumed that active fungal elements (inoculum) lodging in a skin abrasion can cause infection. Therefore, infection due to single dermatophyte or another fungus other

than the one in question should be ruled out as the spores of numerous species of fungi can be transient contaminants or residents in the skin lesions. Hence, the richer community of fungal potential pathogens implies the higher probability of fungal infection in coal-mines areas. Therefore present investigation was effort to confirm the usefulness of the composition of keratinophilic fungi in highly polluted organic deficient coal mines soil to take-up for long-term monitoring studies.

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