

## A Review on Keratinophilic Fungi of Madhya Pradesh

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**Abstract:** In graphically, Madhya Pradesh located in plains between latitude 21°04'N-26.87°N and longitude 74°02'-82°49' E. It's Western and North-Western region receive 1000 mm [39.4 inch] or less and Eastern & South- Eastern region receive as much as 2,150 mm [84.6 inch] or more rainfall in monsoon season. And temperature has Min 15°C to 18°C in January and Max 40°C to 45°C or more in June. These climatic conditions of M.P. are favorable for fungal growth. Keratinophilic fungi are the specialized group of fungi which are able to attack keratinized tissues. These are basically saprophytes but occasionally becomes potentially pathogenic to man and animals and known as dermatophytes. In M.P. studies of keratinophilic fungi are not well pronounced but some good works had done by different workers in this arena. *Chyso sporium indicum*, *Chyso sporium spp.*, *Microsporium gypsum*, *Trychophyton mentagrophytes*, *Malbranchea sp.*, *Anixiopsis sp.*, *Arthoderma benhiman*, *Keratinophyton sp.* are some common keratinophilic fungi reported from soil of Madhya Pradesh.

**Keywords:** keratinophilic fungi, Madhya Pradesh, dermatophytes.

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### I. Introduction

This review presents available data on the present status of study of keratinophilic fungi in Madhya Pradesh. Madhya Pradesh state is exactly located in center of the Bharatiya map so it known as the "Central Region" of Bharat and also known as the "Heart of Bharat" or "Central Bharat". In graphically, Madhya Pradesh state located in plains between latitude 21°04'N-26.87°N and longitude 74°02'-82°49' E, . State Climate is very diverse. Here during Month March to June dry summer season and temperature has 29°C or less and 45°C or more. From June to September Monsoon (Rainfall) comes and Western and North-Western region receive 1000 mm (39.4 inch) or Eastern & South- Eastern region receive as much as 2,150 mm (84.6 inch) or more rainfall. From month October to March temp. goes down and season has cool and dry Winter. In this season the temperature is Min 15°C to 18°C in January.

Fungi with affinities to keratinized tissue are called "**Keratinophilic fungi**". The existence of fungi which are able to attack this kind of tissues is known since as early as 1839 (De Vries 1962). Keratinophilic fungi are present in the environment of all over the world, specifically in keratin containing atmosphere including the human and animal presence. The biological function of keratinophilic fungi in the soil is the degradation of keratinized materials such as hides, furs, hair, feather, claws, nails, horns and skin debris of dead animals. . The Keratinophilic fungi play an important role in decomposing keratinic waste. (Sharma and Rajak, 2003) These are basically saprophytes but occasionally becomes potentially pathogenic to man and animals. The pathogenic forms of fungi are known as "**dermatophytes**" and are known to cause superficial cutaneous infections (dermatophytoses) of keratinized tissues (skin, hair and nails) of humans and animals. Such fungi grow at surface temperatures of 25°C - 28°C with warm and humid conditions which is supported for infection on human skin. Infections by fungi are relatively common in tropical countries due to environmental, social and economic conditions. According to Ainasworth (1973) Keratinophilic fungi which sexual reproduction state is known related to sub-division Ascomycotina, class Plactomycetes, order Eurotials, and family Gymnoascaceae, Onygenaceae and Eurotiaceae. Keratinophilic fungi which sexual reproduction state is not known are classified in three anamorphic (asexual or imperfect) genera, Epidermophyton, Microsporium, and Trichophyton, of anamorphic class Hyphomycetes of the Deuteromycotina (Fungi Imperfecti). (8)

### II. Study Of Keratinophilic Fungi

After Vanbreusghem (1952) several workers have isolated the keratinophilic fungi from soils of all over the world as Pugh and Mathison 1962, Ajello et al, 1965, Frey 1965 Kunert, 1966, Kishimoto and Baker 1967, Ajello and Alpert 1972, Ajello and Padhye 1974, Feuerman et al 1975, Jain 1977, Mercantini et al 1980, Cano et al 1985 etc. (14, 25) Currently, almost all the habitats of the world have been surveyed for the presence of keratinophilic fungi. (Kushwaha, 2000)

In Bharat, many workers have studied keratinophilic fungi such as Dey and Kakoti (1955) in Assam, Randhawa and Sandhu,( 1965) and Garg (1966) in Jammu and Kashmir, Delhi, Rajasthan and Uttar Pradesh; Padhye et al (1966, 1967) in Maharastra; Deshmukh and Agrawal, (1983) in Goa; Jain and Agrawal, (1977) and

Nigam and Kushwaha, (1989) in U.P.; Verma et al.,(1952) in Bihar; Roy et al (1972) and Sur & Ghosh (1980) in Oriss. (Deshmukh, 1983) and so many others were worked in whole Bharat. (4, 14, 18, 25)

### **III. Study Of Keratinophilic Fungi In Madhya Pradesh**

In Madhya Pradesh study on keratinophilic fungi started in 1976 by Kushwaha and Agrawal. After that Deshmukh and Agrawal(1983), Pandey (1986) and Rathore (1987) have done a good work on keratinophilic fungi. Rajak et al (1991), Sharma et al (2008) etc are carried further this work.

In Madhya Pradesh Kushwaha and Agrawal had studied keratinophilic fungi earlier in 1976. They studied soil of Sagar and isolated 94 fungi. In these isolates represent 60 species among 23 genera with 7 sterile forms.. The common reported fungi were 7 species of *Aspergillus*, 7 *Fusarium* sp., 4 species of *Trichoderma*, *Gliocladium* and *Penicillium*, 4 strains of *Chrysosporium tropicum* and *C. crassitunicatum*, 3 species of *Curvularia*, 2 species of *Microsporum*, *Cheatomium*, *Botryotrichum*, *Paecilomyces* & *Verticillium* and 1-species of *Cunninghamella*, *Synecephalastrum*, *Keratinophyton*, *Acrodontium*, *Cephalosporium*, *Cladosporium*, *Fusariella*, *Helminthosporium*, *Hemicola* and *Malbranchea*. Genus *Acrodontium* & *Malbranchea* and several fungal species of *Verticillium* and *Trichoderma*, are first time reported in Bhartiya soil. (Kushwaha and Agrawal., 1976)

A brief survey by Singh & Barde (1990) for superficial mycosis was conducted during November 1978 to September 1979 at Balaghat town in M.P. 75 cases suspected to be of superficial mycosis were selected. Out of 75 suspected cases of superficial mycosis 60 (80%) cases were KOH positive in which 25 cases grew dermatophytes, in 20 cases non-dermatophytes, 4 cases had yeast infection and 2 cases were mixed infections of dermatophytes and non-dermatophytes. The commonest isolate recovered was a dermatophyte *Trichophyton rubrum*, *Hendersonula toruloidea* and *Microascus cinereus*. Other fungi isolated were *Fusarium solani*; *Candida* sp., *Trichosporon* sp., *Aspergillus selerotiorum*, *A. sydowi*, *A. nidulans*, *Geosmithia putteri*Nii, *Eupenicillium parvum*, *Phoma multirostrata*, *Curvularia lunata*, *Chaetophoma dermo-unguis*, *Phialophora bubakii*. The mixed infections were found with *T. rubrum*, *A. nidulans* and *A. niger*.

In 1980 to 1981 Deshmukh and Agrawal had collected the soil from 10 districts of M.P. These districts were Betul, Bhopal, Chhatarpur, Damoh, Jabalpur, Mandla, Narsinghpur, Raisen, Sagar and Seoni. Out of 240 samples only 59.16% are positive. Total 142 keratinophilic fungi isolated belonging to 13 species of 5 different genera. Thirteen species of five genera were *Chrysosporium crassitunicatum* (1.25%), *C. evolceanui* (0.41%), *C. indicum* (39.17%), *C. lucknowense* (0.82%), *C. tropicum* (1.25%), *Chrysosporium* sp. I (0.41%), *Chrysosporium* sp. II (0.41%), *Chrysosporium* sp. III (0.41%), *Keratinomyces ajelloi* (1.25%), *Malbranchea aurantiaca* (2.08%), *Microsporum gypseum* complex (10.8%), *Trichophyton mentagrophytes* (0.41%) and *T. rubrum* (0.41%).

Joshi and Chauhan disitribution of soil mycoflora in four soil types under different plant cover from Chambal ravine of Bhind(M.P.) were studied in 1982. A total of 71 fungal species were isolated. Species of *Cheatomium*, *Khuskia*, *Acrophialophora*, *Alternaria*, *Aspergillus*, *Curvularia*, *Fusarium*, *Hemicola*, *Monocillium*, *Monodictys*, *Myrothecium*, *Penicillium*, *Poma* and *Trichoderma* were identified as common soil fungi .

Alka Pandey (1986) had collected total 45 soil samples from forest, river bank and garbage of Jabalpur. Total 178 fungi were isolated. These represent 82 species belonging to 37 genera and 3 sterile forms. Only 5 genera *Fusarium*(60.8%), *Chrysosporium*(55.5%), *Aspergillus*(46.6%), *Trichophyton*(37.7%) and *Microsporum*(37.7%) were isolated most frequently. Others were *Gliocladium*, *Acremonium*, *Penicillium*, *Scophulariopsis*, *Cladosporium*, *Histoplasma*, *Hemicola*, *Paecilomyces*, *Cheatomium*, *Colletotrichum*, *Cunninghamella*, *Rhizopus*, *Sreptomycetes*, *Absidium*, *Aphanocladium*, *Arthrotrichum*, *Botryotrichum*, *Candida*, *Cephalosporium*, *Cephalophora*, *Curvularia*, *Mucor*, *Synecephalostrum*, *Trichothecium*, *Verticillium*, 5 unknown fungi and 3 *Actinomycetes* also found in Jabalpur soil.

R.S. Rathore, (1987) had studied a total of 532 soil samples were collected from different places of 15 districts belonging to three commissionaries during September 1984 to Sep. 1986. 15 districts are as following:

Sagar commissionary: - 1. Sagar 2. Damoh 3. Chhatarpur 4. Panna and 5. Tikamgarh

Jabalpur commissionary: - 1. Jabalpur 2. Balaghat 3. Seoni 4. Chhindwara 5. Narsinghpur and 6. Mandla

Rewa commissionary: - 1. Rewa 2. Satna 3. Shahdol and 4. Sidhi

Soil samples were collected from cattle farms, poultry farms, forest litter, water source bank, crop field area, gardens, and road side soils and hospital waste soil.

The 227 soil samples collected from different habitats of Sagar commissionary. Only 177 samples yielded keratinophilic fungi. A total of 18 species belonging to 8 different genera were isolated. *M.gypseum* complex was found to be the most prevalent species. These 18 species are *Anixiopsis fulescens*, *Arthroderma benhamiae*, *A. ciferrii*, *Chrysosporium asperatum*, *C. crassitunicatum*, *C. evolceanui*, *C. indicum*, *C. lucknowense*, *C. tropicum*, *Chrysosporium* sp. I, *C. sp. II*, *C. sp. III*, *C. sp. IV*, *Gymnoascoideum petalosporus*,

Keratinophyton terreum, Malbranchea aurantiaca, Microsporium gypseum complex, and Trichophyton mentagrophytes.

A total of 180 soil samples collected from different area and sites of Jabalpur commissionary. Only 160 yielded keratinophilic fungi. A total of 18 species belonging to 8 different genera were identified. *C. indicum* was found to be the most prevalent species and *M.gypseum* was next to it. 18 species from 8 genera were similar to Sagar commissionary.

From different localities of Rewa commissionary were out of 125 soil samples only 98 positive for keratinophilic fungi. A total of 12 species from 5 genera were found. *C. indicum* complex was found to be the most prevalent species and next was *M.gypseum*. Other species are *Anixiopsis fulscens*, *Arthroderma benhamiae*, *A. cifferrii*, *Chrysosporium evolceanui*, *C. indicum*, *C. lucknowenae*, *C. tropicum*, *Chrysosporium* sp. I, *Chrysosporium* sp. II, *Microsporium gypseum* complex and *Trichophyton mentagrophytes*.

Pandey et al (1990) conducted a survey of pathogenic fungi in soils collected from forest, riverside and residential garbage soil in Jabalpur, India. A total of 45 soils samples were examined and 66 species of fungi classified in 35 genera were isolated: *Chrysosporium* (78%), *Fusarium* (69%), *Aspergillus* (47%), *Microsporium* (38%), *Gliocladium* (16%), *Acremonium* (11%), *Penicillium* (11%), *Humicola* (9%), *Scopulariopsis* (7%), *Paecilomyces* (7%), *Cladosporium* (7%); *Chaetomium*, *Colletotrichum*, *Cunninghamella*, *Microascus* and *Rhizopus* (4% each); *Absidia*, *Aphanocladium*, *Arthrobotrys*, *Botryotrichum*, *Candida*, *Cephalophora*, *Cephalosporium*, *Curvularia*, *Histoplasma*, *Mucor*, *Shanorella*, *Syncephalastrum*, *Thermomyces*, *Trichophyton*, *Trichothecium* and *Verticillium* (2% each); mycelia sterilia (6%).

Rajak et al (1991) had studied the ability of five keratinophilic fungi, i.e., *Chrysosporium indicum*, *Geotrichum candidum*, *Gymnoascoideus petalosporus*, *Scopulariopsis brevicaulis* and *Talaromyces trachyspermus* to digest human hair keratin in stationary culture. They found that *Gymnoascoideus petalosporus* showed maximum degradation as compared to remaining isolates when grown on human scalp hair.

Malviya, H. et al (1992) were studied the majority of organic sulphur was oxidized to inorganic sulphate and thiosulphate during hair degradation by four fungal isolates (*Cylindrocarpon lichenicola*, *Graphium cuneiferum*, *Microsporium gypseum*, and *M. fulvum*) from gelatin factory soil of Jabalpur.

For comparative efficacy test of four antimicrobials against Keratophilic fungi by Rai and Qureshi (1995) carried out in Chhindhwara. All the test fungi, viz., *T.terrestris*, *C. tropicum* and *M.gypseum* were isolated from soil by keratin-bait technique. The antimicrobial agents tested against the fungi were Miconazole nitrate, Graphite, Thuja and Chryso-robin. In the present investigation, all the test fungi, viz., *T. terrestris*, *C. tropicum* and *M. gypseum* were sensitive to miconazole nitrate, Graphite, Thuja and Chryso-robin. Miconazole nitrate showed the maximum activity followed by Graphite, Thuja and Chryso-robin.

B. Sharma et al (1997) an examination of soils, for Keratinophilic fungi from residential garbage of Betul, India was presented. A total of 69 fungi representing 39 species among 17 genera were isolated. Only two genera, namely *Aspergillus* (190.9%) followed by *Fusarium* (118.18%) were most frequently isolated. The genus *Fusoma* is reported first time here as a Keratinophilic fungus.

Shukia P. et al. (2003) conducted the isolation and characterization of a Dermatophyte, *Microsporium gypseum* from poultry farm soils of Bicchiya, Rewa (M.P.) Bharat. A total of 37 samples were observed for the presence of this fungi and out of them 25 were found positive for the occurrence of *M. gypseum* (67.56%) .

Lachoria et al (2004) 31 soil samples were collected from different localities of Sagar, District. These samples yielded a total of 34 species belonging to 16 different genera.

Sharma et al (2007) was conducted a survey from 1999 to 2003 as part of a microbial biodiversity study on geophilic and keratinophilic fungi in central India. Among the keratinophilic fungi recovered were 82 isolates belonging to the dermatophyte genus *Microsporium*. *Microsporium persicolor* appeared to be preponderant in central Indian soils, outnumbering the common geophilic species of *Microsporium filvum* and *Microsporium gypseum*.

Deshmukh, S.K. et al (2009) to find out the role of natural fatty material during the process of saprophytic colonization by some keratinophilic fungi from 4 different birds feathers were taken as substrate. In the investigation three fungi i.e., *Keratinophyton terreum*, *Microsporium gypseum* and *Malbranchea aurantiaca* were taken as test fungi. It was concluded that natural fatty materials on feathers have inhibitory effect on their colonization by the test organisms.

Narula N. And Sareen S. (2011) in their work dealt with the isolation and characterization of keratinophilic fungi from different soil sources of Jabalpur. Five different fungi were isolated from various soil sources to be *Geomyces* sp., *Penicillium* sp., *Microsporium* sp., *Aspergillus* sp. and *Candida* sp. 14 different herbs and spices were selected for the antifungal test out of which garlic was found to be the most effective antifungal agent.

Gupta et al (2012) from total 22 samples were found *Aspergillus fumigatus*, *Trichopyton mentagrophyte*, *T. rubrum*, *Epidermatophyton floccosum* and *Chrysosporium* spp. in the soil of Gwalior region.

V. Choudhary and P. C. Jain (2012) fifty soil samples were collected from different habitats of Sagar (25 soil samples) and Jabalpur (25 soil samples) district (M.P.) A total of 141 fungal forms were obtained from the positive samples. These include 56 fungal forms from poultry farm soils, 47 from garden soil and 38 from crop field soils. From these fungi *Aspergillus versicolor* (GS/F/018, PF/F/107) *Aspergillus fumigatus* (GS/F/029, CF/F/051, CF/F/060) *Penicillium* sp. III (CF/F/050, PF/F/140) *Malbranchea* sp. II (CF/F/084) *Aspergillus flavus* (PF/F/096, PF/F/139) are the potential strains.

Pandey et al (2013) were studied 168 cases of local district hospital, Gwalior (M.P.). 143 were positive by direct microscopy in which 125 were positive by culture. Opportunistic fungi isolated from 72 patients. Non-dermatophyte molds accounted 35.2 % with *Aspergillus niger* species (34.09%) being the most common pathogen followed by *Curvularia* (25%), *Aspergillus flavus* (15.9%), *Fusarium* (13.6%) and *Alternaria* (11.3%). *Candida* species was the only yeast like fungi reported (22.4%). They conclude that along with dermatophytes, non dermatophytic fungi are also emerging as important causes of superficial mycosis.

Pandey and Pandey in 2013 a total of 83 samples were collected from suspected cases of tinea from Cancer Hospital, Gwalior (M.P.). The dermatophytes (*Trichophyton* sp. and *Microsporum* sp. were the most prevalent and isolated 85.5 %. *Chrysosporium tropicum* (1.2 %) and *Candida albicans* (13.2 %) were the next common fungi. *T. rubrum* and *T. mentagrophytes* was the most commonly isolated tinea causative agent. *Tinea corporis* is due to a variety of etiologic agents which are *T. rubrum*, *T. mentagrophytes*, *T. violaceum* and *T. verrucosum* and *T. terrestre*. The leading dermatophyte agent of *tinea capitis* is *T. schoenleii*, other dermatophytes such as *Microsporum gypseum*, *T. mentagrophytes*, *T. tonsurans*, *T. terrestre*, *M. fulvum*, *M. audouinii*, *T. verrucosum* and *T. violaceum* are also recovered.

Shrivastav et al (2013) 160 soil samples were collected from different public parks in the Gwalior region of Bharat. Keratinophilic fungi were obtained with some dermatophytic species like *Trichophyton tonsurans*, *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Trichophyton equinum*, *Microsporum nanum*, *Microsporum gypseum*, *Microsporum audouinii* and few non dermatophytes like *Aspergillus niger*. Out of them, *T. mentagrophytes* is the most common (22%) followed by *T. rubrum* (16%) in the region.

128 soil samples of Ujjain (Holy City) were screened by Rathore G. and Jain S. K. in 2014 for keratinophilic fungi. The fungal strains *Microsporum* sp., *Chrysosporium* sp., *Trichophyton* sp., *Penicillium* sp., *Aspergillus niger*, *A. fumigatus*, *A. flavus*, *Aspergillus* sp., *Cladosporium* sp. etc. were frequently isolated.

Agarwal and Khanam (2014) sample collected from five poultry farms of Damoh city M. P. during March 2009. A total of 28 fungi including 10 Keratinophilic and 18 other saprophytic fungi were isolated. *Chrysosporium indicum* is present in almost all the poultry farms sample. Two isolates of this genus could not be assigned to any species level with another unidentified Keratinophilic fungus i.e. *Malbranchea* sp.I. Beside this three unknown Keratinophilic fungi F1, F2, and F3 were also isolated.

Rai et al (2014) soil samples were collected from Jabalpur district. 12 strains of Keratinophilic fungi were isolated and screened for keratinophilic activity and among these 4 (*Fusarium solani*, *Aspergillus niger*, *Penicillium chrysogenum* and *Trichoderma harzianum*) were found to be the most potential Keratinophilic fungi. *Penicillium chrysogenum* showed maximum keratinophilic activity when feathers were used as substrate. *Fusarium solani* showed maximum keratinase activity at 36°C, *Aspergillus niger* at 24°C-28°C, *Penicillium chrysogenum* at 24°C and *Trichoderma harzianum* stain at 32°C.

Iqbal (2015) in Jabalpur (M.P.) clinical isolates and collection strains of *Candida*, *Aspergillus*, *Cryptococcus neoformis*, *Trichophyton rubrum* and *Rhizopus microsporus* were used for antifungal susceptibility test for all antifungal preparations which were purchased from the local market. Zalim lotion exhibited the maximum activity with a halo of 30 mm against *T. rubrum*, *Candida albicans* followed by *C. neoformis* and *Aspergillus niger* than other marked available lotions.

Sharma et al (2015) Soil sample was collected from Bohani village, Madhya Pradesh, and subjected to horse hair baiting, yielded an unusual fungus and described as a new genus, *Matsushimomyces*, with *M. bohaniensis* as type species. A second species, *Polyschema venustum*, is also referred to *Matsushimomyces*.

#### IV. Conclusions

According to present study *Trichophyton* sp., *Microsporum* sp., *Chrysosporium* sp. and *Aspergillus* sp. are very common in soil of M.P.. Soil of M.P. contains many more keratinophilic fungi than those presently recorded, and there is need for further taxonomic and ecological investigation of these organisms. In rural areas of state people such as farmers, labours, children and common men also suffered from several skin problems. To identify the role of keratinophilic fungi in these cases knowledge of the presence of dermatophytic and non-dermatophytic fungi in soil is very necessary.

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