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DETERIORATION OF PAINTED WALL SURFACE BY FUNGAL SAPROBES: ISOLATION AND IDENTIFICATION

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A B S T R A C T

Fungal saprobes were isolated from selected areas of deteriorated painted surfaces from downtown areas of Lahore, Punjab, Pakistan. The purpose of this study was to contribute the knowledge of mycoflora inhabiting the painted wall surfaces in buildings. The standard microbiological techniques were used for isolation and identification of fungal saprobes. The fungi isolated from deterioration of painted wall surface belongs to 12 different species; the most prevalent represents genera *Penicillium, Aspergillus, Colletotrichum, Acremonium, Trichoderma, Fusarium, Curvularia, Mucor* and *Alternaria*. The use of antibiotic coated paint would possibly reduce the bio-deterioration, improve the shelf life and retain the beauty of wall paints.

Keywords: Painted wall, Deterioration, Fungi, Isolation, Identification.

INTRODUCTION

Paint is a liquid used for coating the surface in order to develop a colored covering and to save the walls from disintegration. It is a liquid with viscosity, dehydrating abilities and streaming qualities developed by various chemical formulations. The painted surface undergoes damage or discoloration due to natural weathering, growth and activity of living organisms. Paint also contains a variety of organic and inorganic elements and provides different inhabitant areas that may be utilized by quite a number of microbial species. This often been colonized by different fungi, bacteria and eukaryotic algae (Arino *et al*., 1996).

During summer due to high temperature the humidity level reduces within buildings, there are a comparative low number of spores in the air whereas, in mid-winter with the increase of moisture intensity, the spore concentration also increases. During rainy season infection develop on different places and break down the paint works. These effects could be due to chemicals produced by the fungus. There are many resources of inside pollutions. This includes burning resources such as gas, oil, wood and candlestick and as well as outdoor resources. These contaminants damaged the paint chemical structure and hence occurrence of fungus development might be possible and there by destruction happens. High pollutant may remain in the air for a longer period after some of these activities. Hence increase the chance of fungal development on buildings (Chapman *et al.,* 2007). The aim of this study was therefore to isolate and identify the prevalent fungi deteriorating the painted wall surface of the buildings.

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MATERIALS AND METHODS

Visual study: Samples from the painted surface were collected under aseptic conditions from areas of sampling zone of downtown areas of Lahore, Punjab, Pakistan. Samples were illustrated stained or discolored by scraping off superficial material and plaster to a depth of 2-8 mm. For the sake of maintenance, non-damaged areas were not disturbed. Adhesive tape samples of the painted layer surface were taken for isolation, identification and characterization of fungi. As the surfaces were delicate and insubstantial, a non-hazardous method was applied to isolate micro-organisms (Dhawan and Agrawal, 1986). The techniques used were as follows:

Cotton swab method: Sterilized pure cotton swabs were smoothly rubbed over the delicate surface of painted walls and then presses on Petri plates of Czapek-

Dox Agar (CDA), Malt extract Agar (MEA) and Potato Dextrose Agar (PDA). Petri plates were kept at 25±1ºC for 5 to 7 days to allow microbial development.

Paper Stick method: A 1 cm square piece of filter paper, slightly moistened with sterilized H_2O was gently pressed over the implicated surface, placed in a flask with 5 ml of sterilized H_2O and shaken well. Then 1 ml of suspension was pipette into Petri plates, and CDA, MEA and PDA pour-plates were prepared. The inoculated Petri dishes were then incubated at 25±1ºC for 5 to 7 days and regularly examined. Fungal colonies appeared were counted and sub-cultured on appropriate media for identification.

Identification of Fungal Isolates: The pure cultures of fungus isolated from painted wall using different methods of isolation were identified on the basis of morphological and microbiological characteristics with the help of standard identification keys (Domesch *et al*., 1980). Detailed microbial studies were carried out in Fungal systematic Laboratory, First Fungal Culture Bank of Pakistan (FCBP). All pure culture slants were deposited in FCBP assigning FCBP accession numbers.

RESULTS AND DISCUSSION

The present research exposed the level of destruction of painted areas of wall by fungus. All the samples collected from different points resources were infected with fungus. About 15 samples were exposed to microbial analysis. The cultures isolated from discolored areas of painted wall surface yieled 12 isolates comprising 9 different types of fungal genera viz., *Penicillium, Aspergillus, Colletotrichum, Acremonium, Trichoderma, Fusarium, Curvularia, Mucor* and *Alternaria* (Fig 1). *Aspergillus* genera were found to be most prevalent fungus having 40% of frequency of occurrence. The higher no. of colonies was counted on MEA than on PDA and CDA (Table 1). Identification characteristics of fungal strains encounter were illustrated in Table 2.

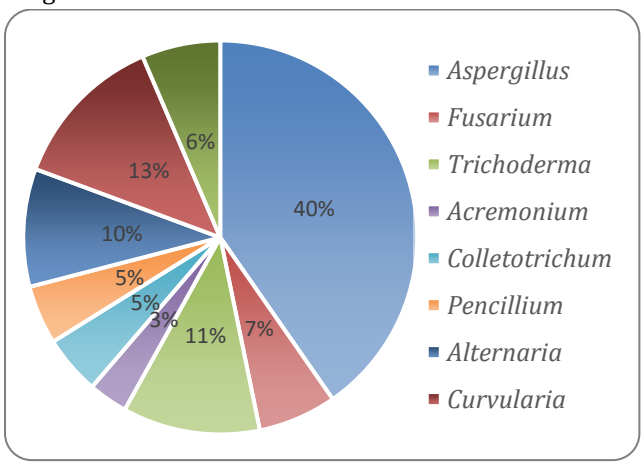

Figure 1. Frequency of occurrence of fungal genera to the indoor environment.

Table I. Mycoflora of painted surface on different growth media.

Fungal species	No. of fungal colonies on different growth media			Total fungal colonies
	MEA	PDA	CDA	
Aspergillus niger	6	2	3	11
Aspergillus flavus	4	3	1	8
Penicillium expansum	2	1	0	3
Aspergillus fumigates	3	1	2	6
Trichoderma sp.	2	3	1	6
Fusarium oxysporum	2	2	0	4
Curvularia clavata	3	4	1	8
Trichoderma viride	1	0	0	1
Acremonium sp.	1	1	0	2
Colletotrichum sp.	2	1	0	3
Mucor sp.	2	1	1	4
Alternaria alternate	1	3	2	6
Total fungal colonies	29	22	11	62

Table 2. Characteristics of fungi isolated from painted wall surfaces.

Isolate Code	Colony morphology	Microscopic morphology	Identity of isolate	FCBP Accession no.
F1	Black, smooth edge, sporulation on surface. Reverse; creamy white to colorless	Conidiophore: Hyaline to slightly brown, thick walled, smooth surface 400-1000x 12-17 µm	*Aspergillus niger*	1296

		Conidia: Brownish, Globose, rough surface, 3.5- 4.5µm Vesicle: Globose to spherical , biseriate , 30-70 µm		
F2	Olive to dark green, sporulated surface, smooth edges, Reverse ; colorless to dull yellow color	Conidiophore:Hyaline to colorless , walls quite rough 400-800 x 8-16 µm Conidia: Green yellow, globose to ellipsoidal, 3-4 µm Vesicle: Spherical to elongate , uniseriate , 20-45 µm	*Aspergillus flavus*	1297
F3	Light green Fruity odor Reverse: colorless to pale yellow	Conidiophore: rough surface, 2-3 stage branched Phialide tip thin walled Conidia: subglobose to ellipsoidal, smooth walled, 3-3.5 µm	*Penicillium expansum*	1305
F4	Grey to dull green, sporulated, smooth edges Reverse; uncolored to dull yellow	Conidiophore:White to colorless, smooth walled 200-400x 5-10µm Conidia: Grey to green, Globose to ellipsoidal, rough surface 2-3 µm Vesicle: Pyriform, uniseriate 15-30 µm	*Aspergillus fumigates*	1377
F5	Green aerial mycelium , yellow pigmentation Reverse ; green to pale yellow	Mycelium: Cottony tufts, short lateral branches having 2-3 phialides Conidia:Green, oblong smooth 4.5-5.5 µm	*Trichoderma* sp.	1379
F6	White, cottony Reverse; pink	Mycelia: Aerial, hyaline to colorless Microconidia: 0-1 septate, blunt Macroconidia: 3-5 septate, curved blunt apical , pedicillate basal part, 25-30x 4-6 µm	*Fusarium oxysporum*	1381
F7	Black to dark brown, thick mate with smooth edges Reverse: black	Conidiophores: dark brown, thick walled, bearing conidia apically and laterally. Conidia: porosporous, subellipsoidal, cylindrical, 4-celled, darker and large central 2 cells. Chlamydospores: globose, pale to dark brown, intercalary	*Curvularia clavata*	1382
F8	Green aerial mycelium , pale yellow pigmentation Reverse ; off white to	Mycelium: Cottony tufts, short lateral branches having 3-4 phialides	*Trichoderma viride*	1385

	pale yellow	Conidia:Green, oblong smooth 3-5.5 µm		
F9	White, smooth , fluffy Reverse; off white	Conidiophores: hyaline, erect, branched bearing spores terminally Conidia: hyaline, 1-celled, cylindrical, 6-8 x 2-3 µm	*Acremonium* sp.	1387
F10	White with black pigmentations Reverse : off white to black	Conidiophores: hyaline, erect, bearing conidia at apex Conidia: hyaline, cylindrical, thick walled, 12- 15 x 3-4 µm Sclerotia: brown, cylindrical	*Colletotrichum* sp.	1391
F11	White fluffy, sporulated surface, Reverse ; colorless to dull yellow color	Sporangiophore:Hyaline to colorless , walls surface smooth 400-800 x 8-16 µm Conidia: light yellow, globose to ellipsoidal, 3-4 µm	*Mucor* sp.	1393
F12	Black to dark brown, sorulated with smooth edges Reverse: black	Conidiophores: dark brown, thick walled, bearing conidia apically and laterally. Conidia: ovoid, ellipsoidal 6-8transvere septa , 1-2 longisepta, 25-35 x 9-12 µm	*Alternaria alternate*	1394

Fungi are necessary for the success of our ecological environment but they may cause an imperative danger to the health of the citizens when they produced in our buildings. During the service life of elements, natural ageing and utmost damage of fundamentals due to different biological, physical and chemical mechanisms can take place (Aina, 2001). Aging of the elements is one part of ecological mechanism and include different biological, mechanical and chemical responses of the components. Bio-deterioration (i.e. molds, mildew and damage from insects in buildings) is triggered when moisture exceeds the tolerance of components which may be a crucial aspect for stability and use of different materials (Hyvarinen *et al*., 2002). Different creatures e.g., viruses, fungi and insects, can construct their development in the building materials; microbiologically fresh components probably do not available, as some contamination begins during initial development levels. Fungus needs various beneficial conditions for their growth in the components. Some of these conditions are beneficial temperature (0-25°C), nutritional value, fresh air and water. On the basis of results founded by Shinkafi *et al.,* (2013) that moisture contents of the habitat is the most imperative factor for the growth of microorganisms. It is concluded that Fungal development on the superficial surface of painted area is a warning that when moisture is absorbed within the room walls and there is sufficient organic material on the walls to support fungal growth which can harm human health by inhaling that spores. The paint quality should be antibiotic coated and moisture repellent.

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