

Isolation and Identification of Fungi Associated with the Deterioration of Painted Wall surfaces within Kaduna Polytechnic

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Abstract: Fungi implicated in the deterioration of painted wall surfaces (both inner and outer surfaces) were investigated within Kaduna Polytechnic. Flakes of paint were collected from different parts of buildings where paint work had started failing. Fungi were isolated from the samples and identified using Sabourard Dextrose Agar and Wet-Mount staining Techniques respectively. The species of fungi isolated from the inner and outer wall surfaces include *Aspergillus*, *Penicillium*, *Botrytis*, *Acrodictys*, *Mucor*, *Absidia*, *Atternaria*, *Cladosporium*, *Rhizopus*, *Cephalosporium*, *Fusarium*, *Helminthosporium*, *Trichocterma*, *Acremonium*, *Pullularia* and *Monilia* special and were implicated in the deterioration of the paint works. Chemical additives such as Ammonium Phosphate and Propionic acid help to hinder the fungal growth on the painted buildings.

Key words: Agar, *Cephalosporium*, *Cladosporium*, humidification devices, sabourard dextrose pectinases, trichoderma

INTRODUCTION

Generally fungi are larger than bacteria with individual cell diameters ranging from 1 to 30mm. Macroscopic fungi exist as either mold or yeast or both. The mold form large multicellular aggregates of long branching filaments called hyper. These tube-like hyper are responsible for the fluffy appearance of the macroscopic mold colony. Yeast, on the other hand are single cells that rarely form filaments. Fleshy fungi produce large macroscopic reproductive structure, the best known examples are the mushrooms and toadstools. The above ground fleshy structures however, represent only part of the organism, most of which grow beneath the fleshy fungi form hyper (Larry and Kandel, 1998).

Among the fungi are organisms that excrete a wide range of degradative enzymes that attack virtually any organic material. Such degradative activities make fungi essential participants in recycling natural waste in our environment. Unfortunately, their degradative proficiency also results in the unwanted growth of fungi that destroy useful materials of every kind such as foodstuff, timber, paints, textiles, leather, plastic, glue etc, even optical glass can be ruined by the presence of fungi which grow on dust particles or cemented films. Fungi in the indoor air is generated from the outdoor air spores by ventilation or they are originated from within the enclosure in which case they are usually limited in variety but may occur in high concentration (Gregory, 1973).

Paint is a fluid applied to surface in layers forming a coloured solid coating. Painting is a fluid with viscosity, drying time, and flowing properties dictated by formulation. During rainy seasons, fungi grow on painted

walls and degrade the painted works. These effects could be as a result of the toxic waste produced by fungi. Therefore, some of these fungi can be cultured, isolated and identified in the laboratory to know why fungi render such havoc on painted works e.g walls. Certain fungal spores which present in the air taken in by people that are allergic cause irritation of varying degrees of intensity which may even result in illness (Stevenson, 1977). There are many sources of indoor air pollutions. This include combustion sources such as oil, gas, kerosene, coal, wood and candle. Products from household cleaning and maintenance coaling systems, personal care or hobbies, central heating and humidification devices as well as outdoor sources such as radon, pesticides and outdoor air pollution are not left behind. (Apter *et al.*, 1994). The relative importance of any single source depends on how much of a given polluted it emits and how hazardous these emissions are. In some cases, factors such as how old the source is and whether it is properly maintained and significant for example, on improperly adjusted gas store can emit significantly more carbon monoxide than one that is properly adjusted. These pollutants might weaken the paints chemical composition hence enhance the incidence of fungi for deterioration. Other sources related to activities carried out in the home, release pollutants intermittently. these include smoking, use of solvents in cleaning, the use of poorly vented or malfunction in stores, furnaces, and the use of paint strippers in redecorating activities and pesticides in home keeping. (D'Mello, 1990) High pollutant concentrations can remain in the air for long periods after some of these activities. Hence, increases the chance of fungi growth on buildings. (Chapman *et al.*, 2007). Outdoor air enters and

leaves a house by infiltration, natural ventilation and mechanical ventilation. In a process known as infiltration, outdoor air flows into the house through openings, joints and cracks in wall, floors and ceilings, and around windows and doors. In natural ventilation air moves through opened windows and doors. (Chapman *et al.*, 2007)

Building are dynamic environment affected by geographical location, climate, heating ventilation and air condition (HVAC) system design and operation, types of building materials used in construction and finishing, moisture intrusion, pest colonization, and human is by far the most common cause of house paint failures such as blistering, peeling (flaking) and staining. It is now well recognized that microorganisms can be responsible for the destruction of buildings and cultural heritages including the decay of concrete, marble and sandstone. (Lyalikova and Petush Kove, 1991).

Objectives of the research:

- To isolate and identify some fungi that cause deterioration an painted wall surfaces
- To identify any of the isolation if they are pathogenic or not.
- To propose certain addition in paint that can help inhibit or reduce the growth of fungi an painted wall surface.
- To suggest any protective measure(s) against the effect of same of the fungi that might be isolated if they are pathogenic on humans.

MATERIALS AND METHODS

This research study was carried out between February August 2010 in the Microbiological laboratories of the Department of Applied Sciences Kaduna Polytechnic Nigeria.

Medium used: The medium used was Sabourard Dextrose Agar. The medium is a common general media for the cultivation of fungi. The medium was sterilized at 121°C for 15 min in an autoclave. All the glassware used were also autoclaved.

Sample collection: The samples of paints were collected from different locations of buildings within the Kaduna Polytechnic buildings where painted work had started failing. The sites of sample collections include Science Laboratory Technology building, Stock Verification Office, Staff toilet in Applied Science Department, female hostel toilet, Central Administration block, Agricultural Engineering Department Workshop, Isa Kaita Library, female hostel waiting room and Textile Technology Department. The samples were collected from both within

and outside of the buildings. The failing paint were scrapped out from the buildings aseptically using a sharp sterilized pen knife into a sterilized block paper and was enveloped immediately to avoid contamination or invasion of other fungi or foreign material into the collected samples. Each sample envelope was labeled appropriately by indicating the site of collection, time/date/place of collection. The collected samples were then transported to the Microbiology laboratory of Kaduna Polytechnic using sterilized cellophane bags.

Medium preparation: The Sabourard Dextrose Agar was prepared strictly according to manufacturers specifications. The media was poured into the petri dishes and was allowed to solidify. The samples collected from the various sites where there were paint failure within Kaduna Polytechnic, which had not lasted for more 24 h were inoculated directly into the medium aseptically using the burning flame to sterilize the surrounding for 3 days at 30°C monitoring the growth on the culture medium. The growth seen on the petri dishes after three days were carefully observed noting the colorations, morphology with microscopic examination carried out on each colony noticed or identified on the petri dishes.

Inoculating techniques: The working benches were thoroughly swapped with methylated spirit soaked in cotton wool, and also a burning blue flame was allowed to sterilize the surrounding air before the inoculation proper. The conical flasks were corked tightly with cotton wool and the petri dishes fully autoclaved.

Staining technique for fungi: Two inoculating needles (straight wire loop), was flamed over the burning Bunsen burner. Then using the inoculating needles, a small or little portion of the growth on the culture plate was transferred into the drop of hactophenol in cotton blue on the slide. The specimen was teased carefully using two inoculating wire loops to avoid squashing of the mycelium and preventing the whole specimen crowding at a point.

RESULTS AND DISCUSSION

From the flakes of paint scrapped from different buildings within Kaduna Polytechnic (both inner and outer wall surfaces), the Table 1 shows the isolates of fungi and their prevalence.

From the series of experiments carried out, it was observed that many fungi were isolated from flakes of paint obtained from the buildings were paint work had started failing within Kaduna Polytechnic. From Table 1, it was observed that fungi isolated from flakes of paint from different buildings include: *Aspergillus*, *Penicillium*,

Table 1: Showing the isolates of fungi from Kaduna polytechnic buildings and their prevalence

Site of sample collection	Part of wall deteriorated	Fungi isolated	Prevalence in culture
Applied science building (SLT)%	Outer paint work	<i>Aspergillus</i>	+++
		<i>Penicillium</i>	++
		<i>Rhizopus</i>	+
		<i>Alternaria</i>	+
		<i>Fusarium</i>	++
		<i>Cladosporium</i>	+
		<i>Mucor</i>	++
Staff-toilet (applied science department)	Inner paint work	<i>Rhizopus</i>	+++
		<i>Aspergillus</i>	++
		<i>Fusarium</i>	+
		<i>Penicillium</i>	++
		<i>Mucor</i>	+
Verification office	Inner paint work	<i>Mucor</i>	++
		<i>Rhizopus</i>	++
		<i>Cephalosporium</i>	++
		<i>Absidia</i>	+
		<i>Aspergillus</i>	++++
H.O.D toilet (applied science department).	Inner paint work	<i>Rhizopus</i>	++
		<i>Aspergillus</i>	+++
		<i>Alternaria</i>	+
		<i>Cephalosporium</i>	+
		<i>Penicillium</i>	++
		<i>Mucor</i>	+
		<i>Acrodactyl</i>	++
Agricultural engineering departmenta building (workshop building)	Outer paint work	<i>Mucor</i>	+++
		<i>Neurospora</i>	+
		<i>Cephalosporium</i>	+++
		<i>Alternaria</i>	++++
		<i>Botrytis</i>	++
		<i>Aspergillus</i>	+
		<i>Monilia</i>	++
		<i>Trichoderma</i>	+++
		<i>Helminthosporium</i>	+
		<i>Absidia</i>	+
		<i>Fusarium</i>	+++
		<i>Acremonium</i>	++
		<i>Trichoderma</i>	++
		<i>Rhizopus</i>	+
		<i>Pencillum</i>	+
<i>Aspergillus</i>	+		
Central admin block	Outer paint work	<i>Fusarium</i>	+++
		<i>Alternaria</i>	++
		<i>Cladosporium</i>	+
		<i>Cephalosporium</i>	++
		<i>Alternaria</i>	+
		<i>Rhizopus</i>	++
		<i>Mucor</i>	+
Library buildings	Outer paint work	<i>Trichoderma</i>	++
		<i>Pullularia</i>	+++
		<i>Cladosporium</i>	+++
		<i>Rhizopus</i>	++
		<i>Aspergillus</i>	+
Female toilet: (female hostel)	Inner paint work	<i>Penicillium</i>	+
		<i>Cephalosporium</i>	++++
		<i>Absidia</i>	++
		<i>Cladosporium</i>	+
		<i>Aspergillus</i>	+++
Female hostel waiting room	Inner paint work	<i>Aspergillus</i>	++
		<i>Cladosporium</i>	+
		<i>Aspergillus</i>	+++
		<i>Penicillium</i>	++
		<i>Monilia</i>	+
Textile department Building	Outer paint work	<i>Fusarium</i>	++
		<i>Cladosporium</i>	++
		<i>Pullularia</i>	+
		<i>Rhizopus</i>	+++
		<i>Acremonium</i>	++
		<i>Mucor</i>	+
		<i>Cephalosporium</i>	++
		<i>Aspergillus</i>	++
		<i>Penicillium</i>	++

+: Sparse; ++: Moderate; +++: Many; ++++: Heavy growth; Identification of fungi was based on the system of Alexopoulos introductory Mycology (1962)

Rhizopus, *Alternaria*, *Fusarium*, *Mucor*, *Cephalosporium*, *Absidia*, *Neurospora*, *Acrodictys*, *Monilia*, *Pullularia*, *Trichoderma*, *Botrytis*, *Helminthosporium* and *Cladosporium*. It was observed that fungi such as *Aspergillus*, *Penicillium*, *Cephalosporium*, *Cladosporium*, and *Rhizopus* were found to be common isolates from the failing painted work as stated by Hodgson *et al.* (1996).

A clear observation also revealed that some fungi found on the outer failed painted work were not found on the inside failed painted work, e.g., *Acrodictys*, *Neurospora*, *Alternaria*, *Acremonium* and *Fusarium* (Table 1). Although, most fungi isolated from the outer failed paint work were also found on the inner failed paint work, e.g., *Aspergillus*, *Penicillium*, *Rhizopus* and *Mucor* (Table 1). These fungi can survive in either outside and inside surfaces of painted walls provided they find the environment conducive for their growth, except like *Neurospora* which requires a specific temperature for growth. In the Agricultural Engineering Department workshop building, isolates such as *Acrodictys*, *Mucor*, *Neurospora*, *Cephalosporium*, *Alternaria*, *Botrylis*, *Aspergillus*, *Monilia*, *Trichoderma*, *Absidia*, *Helminthosporium* and *Fusarium* were isolated. These fungi according to Smith (1960) are mostly associated with farm produce. These fungi must have been brought in along with the agricultural produce/equipment from the farm. Applied Science Departmental Buildings, Agricultural Engineering Buildings, Central Administration block, Isa Kaita Library, Textile Technology buildings had more isolates than the isolates from Staff Toilet (HOD Applied Science), female hostel toilet, female hostel waiting room (where samples were collected from inside the buildings). Paintings should be done according to building specifications. Areas of paintwork deterioration should be scrapped off properly before another layer of paint is applied.

ACKNOWLEDGMENT

The Co-authors like to Acknowledge the Education Trust Fund under the management of Kaduna Polytechnic for sponsoring/ Funding this research study.

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