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**Laboratory Report, General I. A. Q. and Mycological Information**

**Project Location: The Gathering Inn**
**201 Berkeley Ave**
**Roseville, California**

**Client: City of Roseville**

**Lab#: 19MI2869**


Prepared by Greg Candelario, Laboratory Director,
Analytical Chemist and Microbial Consultant

Dear Kristine Faelz,

The following information is the results of the sampling obtained at the site above mentioned. Your company has selected the areas sampled for air sampling analyses using Zefon air cassettes (Non-Viable) as well as surface sampling (Tape-Lift). Please see data sheet for results. For more information and recommendations in this matter feel free to contact us at Adam Laboratories, Inc.

**At the time of this investigation various areas of the bathrooms indicated significant presence of water intrusion and/or visible mold. Some of these areas include walls, ceiling and flooring throughout both bathrooms. A representative number of surface samples (Tape-Lift) collected from some of the areas where visible mold was found showed presence of Cladosporium and Aspergillus/Penicillium (Mold Growth). Some of the building construction material were also found significantly damaged by the water intrusion, especially the sheetrock, particle boards and wood panels near the showers.**

**Two (2) indoor air quality samples were collected inside the bathrooms in order to access the impact of the visible mold identified and no elevated level of fungus/spores was detected at this time. The total spores count found inside the bathrooms was lower than the outdoor sample collected outside the property as reference. Please see data attached to this report for details about findings and sample location. Lab # 19MA2869 & 19MS2869**

For your convenience, the following is an interpretative guideline provided for your use as well as definitions of some of the fungus spores (genus) found in this residence. This information is available from public domain sources and is furnished as a courtesy. Note that the information is provided for the genus level of fungi and that great variation exists among species within a given genus. This information should not be considered comprehensive for any fungi. Qualified health professionals should be consulted for related health effects.

## Aspergillus

There are more than 160 different species of ***Aspergillus***, 16 of which have been documented as etiological agents of human disease. The aspergilli are probably the most common group of fungi in our environment. Many species of the genus are frequently isolated from a variety of substrata, including forage products, grains, nuts, organic debris and water damaged organic building materials.

Because of the ubiquity of the aspergilli within the environment, man is constantly exposed to these fungi. The diseases caused by species of ***Aspergillus*** are relatively uncommon and are rarely found in individuals with normally functioning immune systems. However, due to the substantial increase in populations of individuals with active immune suppression, such as individuals with HIV, chemotherapy patients and those on corticosteroid treatment, contamination of building substrates with fungi, particularly ***Aspergillus*** species have become an increasing concern. Aspergillosis is now the second most common fungal infection requiring hospitalization in the United States.

The most frequently encountered opportunistic ***Aspergillus*** pathogen, ***Aspergillus fumigatus,*** is seen most abundantly in decomposing organic materials. Because it grows well at temperatures up to 55*C, self – heating compost piles provide an excellent environment for the fungi. Compost made up of chipped branches and leaves will often yield a massive and virtually pure culture of ***A. fumigatus***. A. fumigatus has been reported to be the major organism isolated from air samples obtained near compost sites. People who handle compost or decomposing haystacks often develop hypersensitivity to spores of ***Aspergillus*** and after exposure may suffer a severe allergic response.
***Aspergillus flavus*** is the second most frequently encountered fungi in cases of infection with ***Aspergillus*** species. In addition to causing infections, ***Aspergillus flavus*** is also renowned for its production of aflatoxin, one of the most potent carcinogens known to man. Concern about aflatoxin began in the 1960s after some 100,000 turkey poults in Great Britain died as a result of ingesting feed tainted with aflatoxin. When it became evident that aflotoxin was highly carcinogenic most industrialized countries established tolerances for aflatoxin levels in food and feeds. The risks associated with airborne exposure to aflotoxin in contaminated buildings, as with other mycotoxins, have not been adequately studied.

***Aspergillus niger*** is the third most common aspergilli associated with disease and is more common than any other ***Aspergillus*** species within the genus and is found in and upon the greatest variety of substrates. It is commonly associated with "fungus ball", a condition wherein fungus actively grows in the human lung, forming a ball, without invading lung tissue.

Because invasive aspergillosis occurs most frequently among highly immunosuppresed patients, the presence of ***Aspergillus*** spores in hospital air has important implications. ***Aspergillus*** spoes frequently occur in hospitals throughout the world and a number of severe outbreaks resulting in deaths due to disseminated invasive aspergillosis have been reported following renovation activities in hospitals. a study of 39 bone marrow transplant patients who resided in rooms equipped with whole wall laminar flow HEPA filtration units reported no cases of nosocomial aspergillosis. In sharp contrast, 14 cases of nosocomial aspergillosis in 74 bone marrow transplant recipients occurred in patients housed elsewhere. It is critical that aequate engineering controls are implemented during renovations at hospitals or at any facility the immunosuppressed frequent

**Aureobasidium sp.:** Saprophytic or weakly parasitic, common in soils. Indoors A. pullulans is often found in connection with dampness eg. Damp materials in kitchens, bathrooms and on wet frames. This fungus is a problem in weathered wood, as it may grow under paint and discolor the wood. Also it may be resistant to some fungicides used in paint. A. pollulans has been reported to cause chromoblastomycosis (in an immune compromised patient), which is a chronic cutaneous infection of the skin caused by species of dematiaceous fungi. Allergy to Aureobasidium is frequently recorded among atopic patients as a positive skin prick test, but its clinical significance is unknown. Morphology is characterized by producing black and shiny colonies when old. This fungus produces abundant spores (conidia), 1-celled, ovoid, and 5-7 microns in size.
Cultivation: Potato dextrose agar, 24 to 26*C

**Basidiomycetes** are fungi that form spores on a basidium, a trait characteristic of rusts, smuts and mushrooms. This category is commonly found in outdoor air samples. Many species are reported to be allergenic and some species are associated with dry rot in wood. Elevated airborne concentrations indoors might be indicative of water damage or too high humidity.

***Ceratocystis/Ophiostoma Grp.*** is a group of molds commonly referred to as "lumber molds" as they are prevalent on freshly cut lumber used for building construction. Presence of these fungi in indoor environments is common but often is not associated with particulate building moisture problems. Rather, they may be present on the material since the time of construction. The spores or hyphae may become airborne if the wood surfaces that are affected are sanded or remediated. No mycotoxins have been reported from this group but they have been reported to be allergenic (Abbot, 2002).

***Chaetomium sp.*** is found on a variety of substrates containing cellulose including paper and plant compost. Several species of have been reported to play a major role in decomposition of cellulose-made materials. These fungi are able to dissolve the cellulose fibers in cotton and paper and thus cause the materials to disintegrate. The process is especially rapid under moist conditions. During the Second World War countries lost a great deal of equipment to these species. It is reported to be allergenic. It is and ascomycete, in most species, the spores are lemon-shaped, with a single germ pore. The spore column results from the breakdown of the asci within the body of the perithecium. The perithecia of Chaetomium are superficial and barrel-shaped, and they are clothed with dark, stiff hairs. It can produce an Acremonium-like state (imperfect stage) on fungal media.
Cultivation: Potato dextrose agar, 24 to 26°C.

***Cladosporium sp.:*** **(Aw – 0.84 – 0.88).** C. herbarum is the most frequently species found in outdoor air in template climates. Often found indoors, but usually in less numbers than outdoors. The dry conidia, borne in very fragile chains, easily become airborne and transported over long distances. This fungus is often encountered in dirty refrigerators, especially in reservoirs where condensation is collected. On moist window frames, it can be easily seen covering the whole painted area with a velvety olive green layer. Cladosporium often discolors interior paint, paper, or textiles stored under humid conditions. Houses with poor ventilation, houses with thatched straw roof and houses situated I low damp environments may have heavy concentrations of Cladosporium, which will be easily expressed when domestic mold is analyzed. It is commonly found on the surface of fiberglass duct liner in the interior of supply ducts. It is also found on dead plants, woody plants, food, straw, soil, paint, and textiles. The ability to sporulate heavily, ease of dispersal, and buoyant spores makes this fungus the most important fungal airway allergen, and together with Alternaria, commonly csuses asthma and hay fever in the western hemisphere. A few species of this genus cause disease, which range from phaeohyphomycosis, a group of mycotic infections characterized by the presence of dematiaceous septate hyphae. Infections of the eyes and skin by black fungi (also classified as phaeohyphomycosis), and chromoblastomycosis, chronic localized infection of the skin and subcutaneous tissue that follows the traumatic implantation of the etiologic agent are also caused by this fungus. Chromoblastomycosis lesions are verrucoid, ulcerated, and crusted. Skin abscesses,

mycotic keratitis and pulmonary fungus ball have been recorded in immune compromised patients. It may also cause corneal infections, and mycetoma, characterized by localized infections that involve cutaneous and subcutaneous tissue, fascia, and bone consisting of abscesses, granulomata, and draining sinuses, usually in immune compromised hosts. Fungal colonies are powdery or velvety olivaceous-green to olivaceous-brown. Dark conidia 1 – 2 – celled, variable in shape and size, ovoid to cylindrical and irregular, typically lemon-shaped.
Cultivation: Potato dextrose agar, 24°C

**Curvularia sp.:** Reported to be allergenic. It may cause corneal infections, mycetoma and infections in immune compromised hosts. This fungus can be parasitic of saprophytic. Conidiophores brown, mostly simple, bearing conidia apically; dark conidia, end cells lighter, 3- to 5-celled, more or less fusiform, typically bent, with one of the central cells enlarged.
Cultivation: Potato dextrose agar, 24*C

**Epicoccum sp.:**It is commonly found as a secondary invader in plants, soil, grains, textiles and paper products where Cladosporium and Aureobasidium are present. It is mostly saprophytic, or weakly parasitic. Epicoccum is frequently isolated from air, and sometimes from house dust. Reported to be an allergen but not with a high frequency. Due to the ability of this fungus to grow at 37 C, it can cause infection of skin in humans. Morphilogical conidia, several-celled (15-celled), globose, verrucose, 15-25 microns in diameter, and in a fruiting body (sporodochium), which can be visible to the naked eye as pulvinate black spots.
Cultivation: Potato dextrose agar, 24*C.

***Fusarium sp***. is a common soil fungus that is found on a wide variety of plants. Several species produce potent trichothecene toxins, which target the circulatory, alimentary, skin and nervous systems. Symptoms may occur from ingestion of contaminated grains or through inhalation of spores. It is often found as a contaminant of humidifiers. They are reported to be allergenic. It is the most common cause of mycotic keratitis. Frequently involved in eye, skin and nail infections as well as infections in burn patients and other immunocompromised patients

**Memnoniella sp.:** Cellulolytic fungus very closely related to Stachybotrys. Both fungi have a worldwide distribution and often found together, and commonly found I soil. Recent studies on mycotoxins revealed that Memnoniella echinata could have toxicity similar to that of some isolates of S. chartarum. In terms of their chemical products, both S. chartarum and M echinata produce phenylspirodrimanes, but these two organisms differ in that latter produces griseofulvins. Both produce varing amounts of simple trichothecenes. Thus, it is suggested that Memnoniella should also be considered potentially dangerous in indoor air. The conidiophores are dark, simple, bearing at apex a cluster of thick, short phialides; conidia of Memnoniella echinata are very similar to those of Stachybotrys, dark, 1-celled, glubose. The major difference between the two fungi is that the conidia are in long persistent chains (aggregated in slimy heads in Stachybotrys). Also the aerodynamic diameter of Memnoniella is smaller and it would be expected to have an even greater potential to penetrate deep into lungs than the conidia of Stachybotrys.
Cultivation: Corn meal agar, 24*C

***Mucor sp.*** Often found in soils, dead plant material (hay), and horse dung, fruits and fruit juice. It is also found in leather, meat, dairy products, animal hair, and jute. It is almost always in house dust, frequently in air samples and old dirty carpets. Wood chips and sawdust are often attacked by M. plimbeus causing "wood chips disease" and "furrier's lung". Accumulated dust in ventilation ducts may contain high concentrations of viable Mucor spores. Asthmatic reactions to Mucor have been described. It is a Zygomecete fungus that may be allergenic (skin and bronchial tests). It is an opportunistic pathogenic organism and it may cause mucorosis in immune compromised individuals. The sites of infections are the lung, nasal sinus, brain, eye, and skin. Infection may have multiple sites. This organism and othe Zygomycetes will grow rapidly on most fungal media. Conidia (aplanospores) are globose to ellipsoidal, 7-8 microns in diameter, yellowish brown and slightly rough-walled, and are produced in sporangis, which are developed around piriform columella with typical projections. Identification is based o the way sporangia are formed.
Cultivation: Potato dextrose agar, 24°C

***Rhizopus sp.:*** Fungus found throughout the environment. It has been reported to be allergenic and it is often linked to occupational allergy. It may cause mucorosis in immune compromised individuals. It may also zygo mycosis (rhino-facial-cranial area, lungs, gastrointestinal tract, and skin). The disease is associated with the acidotic diabetes, malnourished children, severely burned patients, and other diseases such as leukemia and lymphoma, immunosuppressive therapy, or use of cytotoxins and corticosteroids. The fungi show a propensity for vessel invasion resulting in embolization and necrosis of surrounding tissue. Colonies of this fungus are characterized by a reddish gray-brown mycelium more than 2 cm high. It is easily recognizable by its hylaline to brown stolons, numerous branched brown rhizoids and shiny black sporangia. Spores (sporangiospores) are diminute, rounded to oval thick walled bodies resistant to heat and drought, pale brown and ridged, 7-12 x 6-8.5 microns. Identification is based on the way the sporangia are formed.
Cultivation: Potato dextrose agar, 24°C

***Penicillium sp.*: (Aw 0.78).** A wide number of organisms belong to this genus. Identification to species is difficult. Often found in aerosol samples. Commonly found in soil, food, cellulose, paint, grains, and compost piles. It is commonly found in carpet, wallpaper, and in interior fiberglass duct insulation. Penicillium is reported to be allergenic (skin) and it may cause hypersensitivity pneumonitis and allergic alveolitis in susceptible individuals. It can cause other infections such as keratitis, penicilliosis, and otomycosis. Some species can produse mycotoxins including 1). Ochratoxin, which is damaging to the kidneys and liver and is also a suspected carcinogen; there is also evidence that impairs the immune system. 2). Citrinin that can cause renal damage, vasodilatation, and bronchial constriction. 3). Gliotoxin which is an immunosuppressive toxin, and 3.) Patulin is believed to cause hemorrhaging in the brain and lungs and is usually associated with apple and grape spoilage. It can also cause extrinsic asthma. P. camemberti has been reported as causing occupational allergies in connection with production of soft white cheese, due to inhalation of conidia liberated from the surface of cheeses. P. chrysogenum is often found in moldy buildings where it destroys materials. It also grows well on the glue on the reverse-side of wallpaper and on moist chipboards and is found in plaints. Morphological characteristics of Penicillium include conidiophores arising from the mycelium single, penicilate, ending in a group of phialides; conidia hyaline or brightly colored in mass, 1-celled, mostly globose or ovoid, in dry baspetalchains. Cultivation: Potato dextrose agar or Malt extract agar, 24°C

***Pithomyces sp.*** is found in soil and on decaying plants, especially grasses. It is not reported to be pathogenic, and has not been studied as an allergen

## *Stachybotrys*

Considerable recent media attention has been focused on the fungi **Stachybotrys chartarum (atra)**, particularly in light a number of infant deaths in Cleveland from pulmonary hemosiderosis associated with extensive contamination of residences with this fungus. This coupled with the fact that research indicates that contamination of structures with **Stachybotrys** fungi is much more common than originally believed has led to increased interest.

**Stachybotrys** thrives on water damaged cellulose rich materials in buildings such as sheet rock paper, ceiling tiles, cellulose containing insulation backing and wallpaper. Almost without exception an extended saturation time and/or consistently high levels of humidity are required for this fungi to proliferate. Thus in a majority of cased where **Stachybotrys** is found in buildings the water damage event(s) that has occurred often goes unnoticed, or often as not, ignored by maintenance personnel that are unaware of the implications of such contamination. In sharp contrast, single or sudden water damage events that occur where drying of water damaged material takes place more quickly tend to support the growth of more xerophilic fungi such as **Penicllium** and **Aspergillus** species.

The presence of **Stachybotrys** fungi in buildings is significant because of the mold's ability to produce mycotoxins, metabolites of fungi that can cause adverse health effects in humans and animals. Although most molds produce mycotoxins, those produced by **Stachybotrys** are extremely toxic, are suspected carcinogens and are immunosuppressive. Exposure to these toxins can occur through inhalation, ingestion of dermal exposure. Symptoms of exposure to **Stachybotrys** toxins include dermatitis, cough, rhinitis, nosebleeds, cold and flu symptoms, headache, general malaise and fever. Much of what is known about stachybotrystoxicosis has been gleaned from observation of exposed livestock. Animals exposed to high levels through ingestion of contaminated forage die rapidly due to massive hemorrhaging, both internal and external. Exposure to lower levels over time leads to severe immune system suppression since afflicted animals often suffer from septicemia and succumb to a number of opportunistic infections As a general rule, air sampling for **Stachybotrys** yields unpredictable results because of a number of factors. First, when significant **Stachybotrys** contamination is present, other fungal contaminants are usually present as well. When conducting sampling using Andersen N-6 generally other fungal contaminants will tend to overwhelm the **Stachybotrys** spores in culture, due to their more rapid growth rate, even when using selective media such as cellulose agar. In addition, most commonly encountered fungal spores such as those of Aspergillus and **Penicillium** tend to be much more easily aerosolized than **Stachybotrys** thus further amplifying the recovery of the less significant contaminants. Typically under active growth conditions, the spores of **Stachybotrys** adhere to one another in a sticky sack, making passive aerosolization even more difficult. However, once a **Stachybotrys** contaminated surface has dried for an extended period of time the sticky sack desiccates and the spores are released much more readily.

Because of these factors, a visual inspection of the subject building is the best method of identifying a potential **Stachybotrys** contamination problem and requires a trained eye. Recognizing that **Stachybotrys** constant moisture and cellulose for growth helps the inspector narrow down potential sources. **Stachybotrys** typically appears as a sooty black fungus occasionally accompanied by a thick mass of white mycelia. Bulk or surface sampling of suspect materials should be conducted using caution and removed to the laboratory for identification by light microscopy. New inexpensive techniques are also currently available to measure specific mycotoxins produced by **Stachybotrys** and can assist the inspector in determining the toxicity of the strain isolated. Site-specific analyses should be discussed with the inspector's laboratory.

**Stemphylium sp.:** Reported to be allergenic. Isolated from dead plants and cellulose materials; it can be parasitic or saprophytic. Morphological characteristics; Dark conidia, with cross and longitudinal septa, variable in shape, frequently globose, broadly ellipsoid, or ovoid, often constricted at major septum.
Cultivation: Potato dextrose agar or V-8 juice agar, 24*C

**Ulocladium sp.: (Aw 0.89).** This fungus is reported to be allergenic and considered cosmopolitan. It is commonly found as a saprophyte on plant materials and soils. Some species can be also found on dead herbaceous plants, rotten woods, paper, textiles, and other organic substrates (cellulose). Ulocladium frequently occurs in air and dust samples. Also found on water-damaged building materials such as gypsum boards. Positive skin prick test to U. chartarum is seen in patients with airway allergies to Alternaria. The clinical consequence is that Ulocladium contributes to the allergenic burden of Alternaria-sensitive patients. Conidia are either solitary or in chains, often short ellipsoidal with transverse and longitudinal septa 1-5 in number, similar to those of Stemphylium and Alternaria.
Cultivation: Potato dextrose agar, 26*C

**Interpretive Guidelines:**

**Normal Spore Levels:** Indoor spore levels usually average 30% to 80% of the outdoor spore levels at the time of sampling, with the approximate same distribution of spore types. Filtered air, air-conditioned air or air that is not in the proximity of outdoor sources my drop to 5% to 15% of the outdoor spore levels at the time of sampling. As these are general guidelines, a major factor is the accessibility of outdoor air. A residence with heavy foot traffic, open door and windows, etc., may average 95% of the outdoor levels. An office building with limited air exchange may average as low as 2% of the outdoor levels. Dusty interiors may exceed 100% of the outdoor spore levels but will mirror the outdoor distribution of spore types.

**Problem Interiors:** A substantial increase of one or two spore types, which are inconsistent and not reflective of the outside, spore distribution. This is usually indicative of mold growth.

## Suggested Guidelines for Mold Spore and Skin Cell Fragment Concentrations Residential Buildings (Counts/Cubic Meter) $m^3$

| Suggested Guideline | Total | *Penicillium/ Aspergillus* | Ascospores/ Basidiospores | *Cladosporium* | Zygomycetes | Skin Cell Fragments |
|---|---|---|---|---|---|---|
| "Average" Clean Residence | <1,800 | <600 | <200 | <100 | <100 | <9,000 |
| "Clean" Residence (Maximum) | <3,000 | <1,400 | *<900 | *<800 | <600 | <16,000 |
| Indoor Contamination Present | ***>8,000 | >4,000 | *>1,500 | *>600 | >700 | >20,000 |
| Indoor Amplification May Be Occurring | *>12,000 | >8,000 | *>1,500 | *>1350 | >1,000 | **>30,000 |

Reference: *Airborne Mold Spore Concentrations in Commercial & Residential Buildings*, Daniel M. Baxter, Environmental Testing Associates, San Diego, CA., 1995.

* May depend on outside spore concentration for each species
** Based on mean plus standard deviation of contaminated residences indicating inadequate housekeeping
*** Based on median of contaminated residences

## Summary of Mold Spore Species Distribution

| Building Type | *Penicillium/ Aspergillus* | Ascospores/ Basidiospores | *Cladosporium* | Zygomycetes | Skin Cell Fragments |
|---|---|---|---|---|---|
| "Clean" Commercial Buildings | 37% | 24% | 11% | 5% | 23% |
| "Contaminated" Commercial Buildings | 66% | 6% | 4% | 10% | 14% |
| "Clean" Residential Buildings | 39% | 18% | 21% | <1% | 22% |
| "Contaminated" Residential Buildings | 20% | 76% | 1% | 1% | 2% |
| "Contaminated Buildings Sampled During Drywall Demolition | 92% | <1% | <1% | 5% | 3% |

Reference: *Airborne Mold Spore Concentrations in Commercial & Residential Buildings*, Daniel M. Baxter, Environmental Testing Associates, San Diego, CA., 1995.

### Typical Outdoor Spore Levels for the State of California

**The typical outdoor spore level data presented are the top spore types compiled from the EMLab database of outdoor spore samples for the State of California. Reference: IAQ Pocket Reference Guide. EMLab 2006**

| California Fungal Type | Spores/M$^3$ Low | Medium | High | Frequency % |
|---|---|---|---|---|
| Alternaria | 7 | 27 | 213 | 61 |
| Basidiospores | 13 | 320 | 7307 | 96 |
| Bipolaris/Drechslera group | 7 | 13 | 107 | 14 |
| Botryris | 7 | 25 | 200 | 25 |
| Chaetomium | 7 | 13 | 107 | 19 |
| Cladosporium | 53 | 693 | 6347 | 98 |
| Curvularia | 7 | 13 | 147 | 6 |
| Epicoccum | 7 | 13 | 173 | 20 |
| Nigrospora | 7 | 13 | 200 | 7 |
| Oidium | 7 | 20 | 200 | 22 |
| Penicillium/Aspergillus types | 50 | 213 | 2640 | 90 |
| Rusts | 7 | 20 | 274 | 31 |
| Smuts, Pericornia, Myxomycetes | 10 | 40 | 440 | 72 |
| Stachybotrys | 7 | 13 | 400 | 5 |
| Torula | 7 | 13 | 173 | 14 |

## Data Interpretation and Air Quality Standards

There are no specific regulations governing surface microbiological contamination or airborne microbiological contaminants in indoor air (bioaerosols). This is in part due to the many variables involved with sampling for microorganisms, dramatic fluctuations in background levels of microorganisms, lack of agreement between researchers about what constitutes a "problem situation" and an overall lack of industry experience in interpreting microbiological laboratory data. Therefore, it is critical that the indoor air consultant be able to combine experience and knowledge of microbiology to evaluate laboratory results of samples collected from interior locations.

Thank you for doing business with us.

Prepared by_____

Greg Candelario, Lab Director
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