Microbial Activity and Airborne Culturable Microbial Concentrations in South Georgia Homes

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Microbial Activity and Airborne Culturable Microbial Concentrations in South Georgia Homes

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INTRODUCTION

Statesboro is located on southeast Georgia, and is home to more than 28,000 residents. Many residents are college students that live within city limits but beyond the Georgia Southern University campus, there are even more rural and older homes. One thing both the newer and older built homes have in common is the presence of moisture leading to indoor microbial activity. Microbial activity is most commonly found in the form of bacterial and mold growth. Indoor microorganisms and microbial allergens can lead to harmful respiratory effects in the human body such as allergies, asthma, chronic bronchitis, infections, and even contamination of food stuffs.

METHODS

In order to measure levels of total ATP in the houses sampled, we swabbed the settled dust in homes and also conducted sampling of airborne culturable molds and bacteria in parallel. ATP levels were determined in swabbed dust samples collected from 10 cm² floor surfaces using a kit, which utilized luciferin-luciferase fluorescence reaction and a luminometer, which then quantified ATP levels as relative light units (RLU). The rug or carpet and hardwood was swabbed then inserted into the kit and the ATP reading was given.

RESULTS

After completing sampling in twenty different homes we were able to gather average for relative light units of ATP and microbial colony forming units from the air samples.

- **RLU average and SD of carpet/rugs:** 1037.2±931.79
- **RLU average and SD of hardwood:** 812.8±1142.64
- **Mold average and SD:** 219.7±201.56 CFU/m³
- **Bacteria average and SD:** 401.4±246.98 CFU/m³

**Figure 1. Results of incubated plates: MEA (left) and TSA (right)**

For air sampling, a BioStage viable impactor was utilized. This impactor is composed of an inlet cone, a 400-hole impactor stage, and a base that holds a standard-size agar plate. A pump connected to this impactor pulls microorganisms in air at 28.3 L/min flow rate on the agar surface for approximately five minutes. Two different types of agar plates were used: MEA (malt extract agar) to culture molds and other fungi, and TSA (tryptic soy agar) to culture bacteria. After sampling, agar plates were taken back to the laboratory and incubated at 30±2°C for 24 to 72 hours. Colony counts were converted to airborne concentrations (CFU/m³) after positive hole corrections.

**Figure 2. Box plots showing the concentration levels of airborne molds and bacteria (units and RLU levels in airborne dust samples) from 20 homes. The lower and upper boundaries of the box specify the 25th and 75th percentiles, respectively. The line within the box indicates the median and the whiskers above and below the box indicate the 95th and 10th percentiles, respectively.**

FOR molds, any value less than 100 CFU/m³ is considered acceptable living circumstances. Any value falling within 100-500 CFU/m³ is worthy of an investigation for pathogenic fungi. Values over 500 CFU/m³ are unacceptable and it is advise a remediation is called for in the short term.

For bacteria, any value less than 500 CFU/m³ is considered acceptable living circumstances but once values increase to around 4,000 CFU/m³ is when it become unsuitable for living.

There is a definite positive value for RLU in both the carpet and hardwood samples that were taken. This means ATP is present and its cause is likely to be from microbial agents. Further testing was done to measure the colony forming units of molds (on MEA plates) and bacteria (on TSA plates). We found a weak positive correlation (r = 0.161) between microbial activity in carpets and airborne culturable microorganisms (however, this was not statistically significant; p = 0.512) indicating that carpet dust could be a source for airborne microbes unlike hardwood, whose RLU levels did not show any positive correlation trend with colony forming units (r = -0.027; p = 0.908). This observation indicates that the relationship between dust and airborne microbes is complex.

**Figure 3. CFU and Hardwood RLU Correlation**

**Figure 4. CFU and Carpet RLU Correlation**

CONCLUSIONS

The average molds level collected in our samples falls below the unacceptable range but some may still be worthy of an investigation. The average bacterial concentration collected from samples is within the acceptable and safe range. The positive correlation between CFU of molds and bacteria and ATP in carpet shows that there is definitely abundant microbial activity in these carpets, some at higher ranges than others. We will continue to take samples in order to have a larger sample size and be able to further observe these correlations and any other correlations there might be with the health history of sampling participants.

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