Comparing Fungi Presence in Various-Aged Homes in SE Texas

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Introduction

Fungal spores are normal components of outdoor & indoor air.

In homes, most researchers agree indoor spores should be similar to those outdoors and the levels should be lower [2,3]. In small amounts, mold spores are usually harmless. However, unchecked, molds can produce allergens and irritants that can trigger allergies, difficulty breathing, and headaches [4,5].

Thus, there should be **indicators** homeowners and landlords can use to predict when spore levels will be high to avoid proliferation of fungi in homes and get treatment accordingly.

Summary

The objective of this study is to determine whether (1) there is a correlation between fungal presence and the age of a home, and (2) what types/levels of fungi tend to exist at certain ages inside homes. The results of the study can be helpful to homeowners as they can determine whether to test and treat their homes at certain age checkpoints.

Based on data available, there is no study that specifically isolates the age variable of a home against airborne fungal growth. This is a very micro-level study and results are hyper-specific to homeowners and landowners in Southeast Texas.

Hypothesis: Older homes will have more spores in the air, which indicates higher levels of fungi presence. Specifically, as age increases, homes will have higher levels of *Penicillium/Aspergillus, Basidospores, and Cladosporium*, as these are three of the most common categories of both outdoor and indoor fungi that exist in almost every home.

Methodology

Five homes of similar size and type in SE TX were selected. Each house is referenced only by number and age (see Table 1).

Air samples were collected utilizing a battery operated pump and Air-O-Cell cassettes with a volume of 75 L. In each house, one indoor (bedroom) and one outdoor (porch) sample was taken.

For analysis, raw count was taken and a company calculation determined the spores/m^3. Pollen is also included.

Figure 1: *Radius of locations of homes tested. Courtesy of OpenStreetMap.*

Results

Below are the readings of each sample (Indoor and Outdoor for each home) organized by spore type.

Table 1: Prevalence of Spore Types Across Indoor and Outdoor Samples of Each House

Spore Type	House 1 (<1 yr.)		House 2 (8 yrs.)		House 3 (16 yrs.)		House 4 (28 yrs.)		House 5 (41 yrs.)	
	Indoor	*Outdoor*	*Indoor*	*Outdoor*	*Indoor*	*Outdoor*	*Indoor*	*Outdoor*	*Indoor*	*Outdoor*
Total (spores/m^3)	**1130**	**1330**	**78**	**2310**	**637**	**4600**	**4270**	**3550**	**286**	**1640**
Alternaria(=Ulocladium)	—	39	13	13	—	—	—	52	26	39
Ascospores	104	208	—	634	52	3020	52	780	—	156
Basidiospores	104	260	—	572	52	1140	26	832	104	624
Bipolaris/Drechslera	—	—	—	13	—	—	—	—	—	
Cladosporium	312	520	—	676	312	156	4000	884	52	624
Culvularia	13	—	13	13	13	—	13	104	—	—
Epicoccum	52	13	—	—	52	—	—	39	39	65
Nigrospora	—	—	—	26	—	—	—	39	—	
Penicillium/Aspergillus	468	260	52	312	156	208	182	728	52	104
Polythrincium	—	—	—	26	—	—	—	13	—	
Smuts/Periconia/Myxomy	—	13	—	39	—	65	—	—	13	26
Tetraploa	13	—	—	—	—	—	—	—	—	
Torula	—	—	—	—	—	—	—	13	—	
Pithomyces	52	13	—	—	—	—	—	13	—	
*Colorless/Other Brown**	13	—	—	—	—	—	—	39	—	
Pollen	26	559	13	689	195	312	26	117	130	3575

All data is reported in spores/m^3. Pollen is not included in total count.

**Colorless/Other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.*

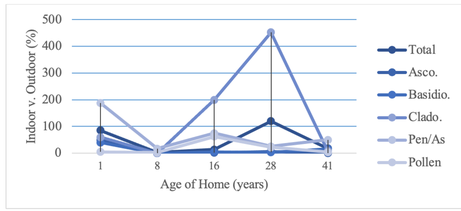
Below are depictions of the ratio between Indoor and Outdoor spores for the most abundant types.

Table 2: Ratio of Most Abundant Indoor to Outdoor Spores in Each House by Spore Type

Spore Type	House 1	House 2	House 3	House 4	House 5
Total	**84.96**	**3.38**	**13.85**	**120.28**	**17.44**
Ascospores	50.0	0	1.72	6.67	0
Basidiospores	40.0	0	4.56	3.13	16.67
Cladosporium	60.0	0	200.0	452.49	8.33
Penicillium/Aspergillus	188.07	16.67	75.0	25.0	50.0
Pollen	5.19	1.89	62.50	22.22	3.64

All data is reported in % of Indoor vs Outdoor Spores in spores/m^3 from Table 1.

Figure 2: Most Abundant Indoor vs Outdoor Spores (%) vs. Age of Home



Pictured are examples of readings made under the microscope.

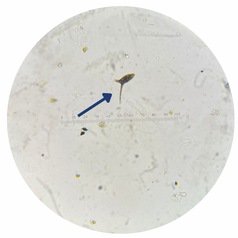


Figure 3: *Tetraploa spore on House 1 Indoor sample at 200X magnification.*

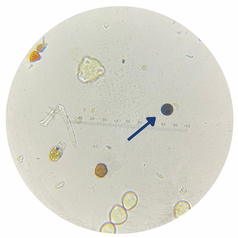


Figure 4: *Nigrospora spore with pollen on House 2 Outdoor sample at 400X magnification.*

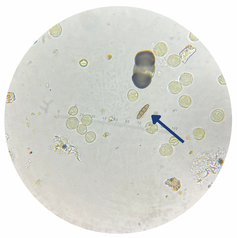


Figure 5: *Torula spore with pollen on House 4 Outdoor sample at 400X magnification.*

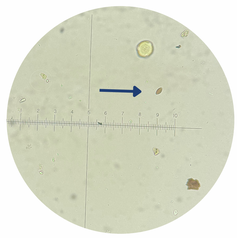


Figure 6: *Basidiospore spore on House 5 Indoor sample at 400X magnification.*

Findings

For the bedroom analyzed in each house, Table 1 depicts House 1 with 1130 spores/m^3 total, House 2 with 78 spores/m^3, House 3 with 637 spores/m^3, House 4 with 4270 spores/m^3, and House 286 with spores/m^3. The large variability suggests that number of total spores does not necessarily increase as age increases. This is the same for most spores including the most common groups: *Asco., Basidio., Clado. and Pen./As*. Table 2 and Figure 2 uses the outdoor sample as comparison for the number of spores indoor, and the ratios for the most abundant spores do not directly support the hypothesis. However, pollen seems to increase as the age of the home increases.

Conclusion: Age of a home does not seem to correlate to fungal presence. While Clado., Pen./As., and Basidio. are the most common spores in homes, they do not increase with age.

Discussion

Ultimately, the study was not able to isolate age of home as an indicator of a certain level of fungal presence. Instead, the results lead us to believe individual factors (i.e. how families live inside their homes) triumph over age of the home in determining spore levels in the air. **This incentivizes future studies to determine those exact factors to help homeowners.**

Notably, pollen, which was only added to confirm the difference between the outdoor and indoor sample, seemed to increase as the home aged. Thus, as an unintended result of the study, pollen in a home increased as age of a home increased, likely due to more exposure to outside air over time.

The sample size of the study was limited due to time constraints and resources. If replicated on a larger scale, the results could vary and be more definite.

References

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[3] American Industrial Hygiene Association (AIHA). Field Guide for the Determination of Biological Contaminants in Environmental Samples. Fairfax, VA. AIHA Press, 1996.
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[5] "Fungal Descriptions." SEEML Labs.
[6]Codina, R et al. "Typical levels of airborne fungal spores in houses without obvious moisture problems during a rainy season in Florida, USA." Journal of investigational allergology & clinical immunology vol. 18,3 (2008): 156-62.

Acknowledgments

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