

Quantitative, Real-Time Polymerase Chain Reaction Analysis

American Relative Moldiness Index (ARMI)

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Inspector:	Certified Industrial Hygienist	Collected: 01/01/10
Project:	Moldy Home	Received: 01/01/10
Job #:	CI09123	Reported: 01/02/10
Assured Bio ID:	CIH010110-1	Analyst: M. McGraw, J. Wu

Assured Bio Labs, LLC. operates under ISO 17025:2005 and a US-EPA license for MSQPCR (# 416-07)

Notes

The American Relative Moldiness Index (ARMI) is a Quantitative, Real-Time Polymerase Chain Reaction (QPCR) panel of testing for indoor molds that was developed by the United States Environmental Protection Agency (US-EPA). This panel includes 13 species of molds also found in the more comprehensive Environmental Relative Moldiness Index (ERMI) panel. The ARMI was developed by the United States Environmental Protection Agency to be a cost-effective survey of the mold burden in a home. Each species and group of species is enumerated from DNA extracted from dust samples taken from both the living and sleeping quarters of homes.

Selected References

1. Haugland, R. A. and S. J. Vesper. **2002**. Method of identifying and quantifying specific fungi and bacteria. US Patent 6,387,652 B1.
2. Vesper, S. J. **2006**. Developing the EPA Relative Moldiness Index® based on mold-specific quantitative PCR. *The Synergist* **April 2006**:39-43.
3. Haugland, R. A., S. J. Vesper and L. J. Wymer. 1999. Quantitative measurement of *Stachybotrys chartarum* conidia using real time detection of PCR products with the TaqMan™ fluorogenic probe system. *Molecular and Cellular Probes* **13**:329-340.
4. Meklin, T. M., R. A. Haugland, T. Reponen, M. Varma, Z. Lummus, D. Bernstein, L. J. Wymer and S. J. Vesper. **2004**. Quantitative PCR analysis of house dust can reveal abnormal mold conditions. *Journal of Environmental Monitoring* **6**:615-620.
5. Vesper, S. J., C. McKinstry, C. Yang, R. A. Haugland, C. M. Kercksmar, I. Yike, M. D. Schluchter, H. L. Kirchner, J. Sobolewski, T. M. Alltan and D. G. Dearborn. **2006**. Specific molds associated with asthma in water-damaged homes. *Journal of Occupational and Environmental Medicine* **48**:852-858.



Guidelines to Follow When Interpreting an ARMI SCORE

(See illustration two for ARMI diagnostic chart)

The Asthma and Allergy Foundation of America has classified the following symptoms for mold allergies:

- Sneezing
- Chronic cough
- Runny nose
- Nasal congestion
- Itchy, watery and red eyes
- Skin rashes and hives
- Sinus headaches
- Reduced lung capacity and difficulty breathing

Mold-exposure symptoms differ from person to person, depending upon the sensitivities of each individual and their levels of exposure to mold. Persons that are extremely sensitive to mold, or those with suppressed immune systems, could be at higher risk for allergic reactions than those that are less sensitive and have full immune system function. Reaction to mold exposure can be immediate or delayed, depending on the individual and their susceptibility and exposure levels.

The US-EPA has developed a 13-species panel of Mold-Specific Quantitative Polymerase Chain Reaction (MSQPCR) analyses called the American Relative Moldiness Index (ARMI). The ARMI is an abbreviated panel of analyses that are found in the more comprehensive Environmental Relative Moldiness Index (ERMI), which is composed of 36 species of mold. House dust is used as the medium for both the ERMI and ARMI panels. Quantities of these species in 1 mg of dust are used to derive an "ERMI Score" that rates the moldiness of a home, based upon scores from approximately 1100 homes tested in the US. Assured Bio, LLC recognizes three broad categories of "moldiness" that are of particular importance to occupants of homes. These levels and possible health implications are listed in the table below.

It should be noted that there is no implicit human-health recommendation with an ARMI score. An ARMI score should be used in conjunction with individual mold species quantifications and symptoms of home occupants to arrive at an action decision. An ARMI score is simply a guideline for determining levels of mold exposure for home occupants. A detailed diagnostic chart is on the next page. As research by the US-EPA and Assured Bio, LLC accumulates, interpretations of ARMI scores could change.



AMERICAN RELATIVE MOLDINESS INDEX (ARMI)

ARMI = (-1.6 to 4.2) MODERATE
Mold-exposure symptoms will vary with the individual. Some individuals exhibit a greater sensitivity to mold than others.



ARMI = (below -1.6) LOW
These homes hold the lowest ARMI value. Occupants of these homes are least likely to show symptoms of mold exposure. However, mold-exposure symptoms are not impossible.

ARMI = (above 4.2) High
Occupants of these homes are the most likely to show mold-exposure symptoms. However, mold-exposure symptoms are not certain. Some individuals who are least sensitive to mold may remain asymptomatic even when the ARMI score exceeds 5.



Key to ARMI Assays

<u>Assay name</u>	<u>Target species / group of species</u>
<u>Group 1 Molds</u>	
Anigr	<i>Aspergillus niger / awamori / foetidus / phoenicis</i>
Aochr1	<i>Aspergillus ochraceus / ostianus</i>
Apeni2	<i>Aspergillus penicillioides</i>
Arest	<i>Aspergillus restrictus / caesillus / conicus</i>
Asydo3	<i>Aspergillus sydowii</i>
Cglob	<i>Chaetomium globosum</i>
Eamst	<i>Eurotium (Aspergillus) amstelodami / chevalieri / herbariorum / rubrum / repens</i>
Pvari2	<i>Paecilomyces variotii</i>
Pchry	<i>Penicillium chrysogenum</i>
Wsebi	<i>Wallemia sebi</i>
<u>Group 2 Molds</u>	
Aaltr	<i>Alternaria alternata</i>
Cclad1	<i>Cladosporium cladosporioides</i> svar. 1
Cherb	<i>Cladosporium herbarum</i>



Sample ID: CIH010110-1-1

Description: Master Bedroom and Living Room

Group 1 Molds	Spores/mg dust	Group 2 Molds	Spores/mg dust
Anigr	ND	Aaltr	2
Aochr1	ND	Cclad1	119
Apeni2	1,020	Cherb	330
Arest	ND		
Asydo3	11		
Cglob	ND		
Eamst	741		
Pvari2	5		
Pchry	ND		
Wsebi	ND		

ARMI Score: 2.7