Quantitative, Real-Time Polymerase Chain Reaction Analysis

Environmental Relative Moldiness Index (ERMI)

228 Midway Lane, Suite B
Oak Ridge, TN 37830

Phone: (865) 813-1700
Fax: (865) 813-1705

www.assuredbio.com

Inspector:	Certified Industrial Hygienist	**Collected:**	01/01/10
Project:	Moldy Home	**Received:**	01/02/10
Job #:	CI012453	**Reported:**	01/03/10
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 Environmental Relative Moldiness Index (ERMI) 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 26 mold species and groups of species that are known to thrive in water-damaged homes. This panel also includes 10 species and groups of species of molds that are found in all homes, with or without water damage. Each species and group of species is enumerated from DNA extracted from dust samples taken from both the living and sleeping quarters of homes. Concentrations of each of the 36 molds are used to derive an "ERMI Score" that rates the "moldiness" of each sample against those tested by the US-EPA. These values range from approximately -10 (low moldiness) to 20 (high moldiness).

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 TaqManTM 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. Kercsmar, 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.

Disclaimer

ERMI analytical data contained within this report only reflects both the historic and current mold burden within the property tested as of the day the sample was collected. Future mold growth is unknown and can be influenced by water intrusion events such as elevated moisture, condensation, structural or plumbing leaks and/or acts of God (major storm events) that occur subsequent to the ERMI test for which results are documented within this report. If a previous mold remediation was conducted in the property for which these results are being reported, conclusions can only be drawn concerning the current mold burden of the property, not the historic mold burden of the property. The effect of a previous mold remediation or clean-up on the current mold burden of the property is subject to a variety of confounding factors, and drawing conclusions regarding the historic mold burden are cautioned against, unless an ERMI test was conducted following the remediation. In such a case, where an ERMI sample was analyzed following mold remediation, the results of this report should be compared to the post remediation ERMI test data to make inference concerning the historical mold burden of the property. Note: Other forms of post remediation (spore-trap, culturable fungi, etc) are invalid for historic comparison with the ERMI test results contained in this report.

Guidelines to Follow When Interpreting an ERMI SCORE

(See illustration two for ERMI 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.

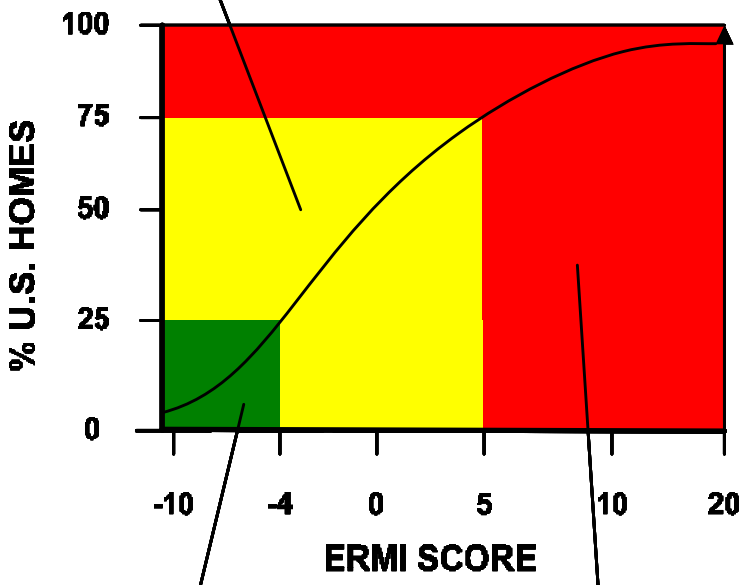
The US-EPA has developed a 36-species panel of Mold-Specific Quantitative Polymerase Chain Reaction (MSQPCR) analyses called the Environmental Relative Moldiness Index (ERMI). House dust is used as the medium for this test. Quantities of these species in 1 mg of dust are used to derive an "ERMI Score" that rates the moldiness of a home, based upon scores from approximately 1100 homes tested in the US. Assured Bio 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 ERMI score. An ERMI score should be used in conjunction with individual mold species quantifications and symptoms of home occupants to arrive at an action decision. An ERMI 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 ERMI scores could change.

We have included the sums of the logs of Group 1 and 2 mold species. These are used for calculating the ERMI score. However, the sum of the logs of Group 2 molds can also be used as a general indicator. This value should be between 7-14 for a home in which mold species have come into equilibrium with outdoor species. Values lower than this usually indicate that the home is new and has not yet equilibrated to the outdoor environment. Values are also commonly low after a remediation event. Values that are high could indicate that cleaning regimes are insufficient, or that a water intrusion event was large enough to cause Group 2 molds to grow in number along with Group 1 molds.

ENVIRONMENTAL RELATIVE MOLDINESS INDEX (ERMI)

ERMI = (-4 to 5) MODERATE
Mold-exposure symptoms will vary with the individual. Some individuals exhibit a greater sensitivity to mold than others.



ERMI = (-10 to -4) LOW
These homes hold the lowest ERMI value. Occupants of these homes are least likely to show symptoms of mold exposure. However, mold-exposure symptoms are not impossible.

ERMI = (5 to 20) 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 ERMI score exceeds 5.

Key to ERMI Assays

Assay name	Target species / group of species
Group 1 Molds	
Afumi	*Aspergillus fumigatus, Neosartorya fischeri*
Aochr1	*Aspergillus ochraceus / ostianus*
Arest	*Aspergillus restrictus / caesillus / conicus*
Asclr	*Aspergillus sclerotiorum*
Aungu	*Aspergillus unguis*
Avers2-2	*Aspergillus versicolor*
Apeni2	*Aspergillus penicillioides*
Cspha	*Cladosporium sphaerospermum*
Eamst	*Eurotium (Aspergillus) amstelodami / chevalieri / herbariorum / rubrum / repens*
Ppurp	*Penicillium purpurogenum*
Stac	*Stachybotrys chartarum*
Aflav	*Aspergillus flavus / oryzae*
Anigr	*Aspergillus niger / awamori / foetidus / phoenicis*
Asydo3	*Aspergillus sydowii*
Apull	*Aureobasidium pullulans*
Cglob	*Chaetomium globosum*
Pvari2	*Paecilomyces variotii*
Pbrev	*Penicillium brevicompactum / stoloniferum*
Pcory	*Penicillium corylophilum*
PenGrp2	*Penicillium crustosum / camembertii / commune / echinulatum / solitum*
Pspin2	*Penicillium glabrum / lividum / purpurescens / spinulosum / thomii*
Pvarb2	*Penicillium* variable
SCbrv	*Scopulariopsis brevicaulis / fusca*
SCchr	*Scopulariopsis chartarum*
Tviri	*Trichoderma viride / atroviride / koningii*
Wsebi	*Wallemia sebi*
Group 2 Molds	
Astrc	*Acremonium strictum*
Aaltr	*Alternaria alternata*
Cclad1	*Cladosporium cladosporioides* svar. 1
Cclad2	*Cladosporium cladosporioides* svar. 2
Cherb	*Cladosporium herbarum*
Austs2	*Aspergillus ustus*
Enigr	*Epicoccum nigrum*
Muc1	*Mucor amphibiorum / circinelloides / hiemalis / indicus / mucedo / racemosus / ramosissimus and Rhizopus azygosporus / homothalicus / microsporus / oligosporus / oryzae*
Pchry	*Penicillium chrysogenum*
Rstol	*Rhizopus stolonifer*

Sample ID: ClH010110-1-1

Description: Master Bedroom and Living Room

Group 1 Mold Species	Assay Name	Spores/mg dust
Aspergillus fumigatus	Afumi	7
Aspergillus ochraceus	Aochr1	ND
Aspergillus restrictus	Arest	ND
Aspergillus sclerotiorum	Asclr	370
Aspergillus unguis	Aungu	ND
Aspergillus versicolor	Avers2-2	ND
Aspergillus penicillioides	Apeni2	ND
Cladosporium sphaerospermum	Cspha	42
Eurotium amstelodami	Eamst	ND
Penicillium purpurogenum	Ppurp	ND
Stachybotrys chartarum	Stac	567
Aspergillus flavus	Aflav	ND
Aspergillus niger	Anigr	ND
Aspergillus sydowii	Asydo3	2,696
Aureobasidium pullulans	Apull	ND
Chaetomium globosum	Cglob	ND
Paecilomyces variotii	Pvari2	1
Penicillium brevicompactum	Pbrev	ND
Penicillium corylophilum	Pcory	ND
Penicillium crustosum	PenGrp2	4,392
Penicillium glabrum	Pspin2	ND
Penicillium variable	Pvarb2	ND
Scopulariopsis brevicaulis	SCbrv	1,654
Scopulariopsis chartarum	SCchr	ND
Trichoderma viride	Tviri	ND
Wallemia sebi	Wsebi	2

Group 2 Mold Species	Assay Name	Spores/mg dust
Acremonium strictum	Astrc	ND
Alternaria alternata	Aaltr	197
Cladosporium cladosporioides svar. 1	Cclad1	ND
Cladosporium cladosporioides svar. 2	Cclad2	ND
Cladosporium herbarum	Cherb	444
Aspergillus ustus	Austs2	ND
Epicoccum nigrum	Enigr	ND
Mucor amphibiorum	Muc1	1
Penicillium chrysogenum	Pchry	ND
Rhizopus stolonifer	Rstol	ND

Sum of logs of Group 1 species:	18.3
Sum of logs of Group 2 species:	4.9

ERMI Score: **13.4**