MICROBIAL PLEOMORPHISM IN A RELATIVE HUMIDITY GRADIENT

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Background: The availability of water is the most important predictor for the occurrence of microbial growth on solid/air interfaces. This availability is determined by the surrounding relative humidity (RH).

Objectives: Studying adaptations of microbial growth in a RH gradient.

Methods:

Design of RH gradients in closed systems making use of a temperature gradient and/or saturated salt solutions.

Microbial adaptations and limitations were studied using several microscopic techniques and complemented with proteomics studies.

Results: Distinct differences in morphology and growth patterns were observed between populations of the same species growing at different RH. Staphylococcal species increased in cell size as they approached their RH growth limit and started growing in tetrad/cubical formations instead. Gram-negative rods grew in wave-like patterns, forming larger waves as they became increasingly filamentous at low RH. The Gram-positive bacterium Bacillus subtilis became shorter, curved, and eventually almost coccoid. The altered morphology and/or growth patterns of microorganisms growing at low RH might be more ecologically relevant than their textbook appearance at high RH since their natural habitats are often dry. Transmission electron microscopic analyses revealed that staphylococci grown at low RH have thicker cell walls, which may explain why these cells are also more vancomycin resistant. On an intracellular level, proteomics analyses focus attention on the physiological changes in gram-positive organisms exposed to different relative humidities.

Conclusions: We conclude that RH strongly influences the growth of microbes. Low RH changes the morphology and modifies physiological traits such as antibiotic resistance.

References: Marcus C. de Goffau,* Xiaomei Yang, Jan Maarten van Dijl and Hermie J. M. Harmsen, Bacterial pleomorphism and competition in a relative humidity gradient. Environmental microbiology (2008), published online.