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Assessment of bacterial load in the indoor air of a poultry house : evaluation of the performance of real-time quantitative PCR

[1]Rinsoz T., [1]Oppliger A., [2]Duquenne P.

Institut universitaire romand de Santé au Travail[1], INRS, laboratoire de métrologie des aérosols, 54501 Vandoeuvre, France[2]

INTRODUCTION: Workers in poultry houses are exposed to very high level of airborne micro-organisms, which have been recognized as a cause of respiratory symptoms. Estimating the airborne bacterial load of poultry houses is a key point to evaluate the risk for the workers. Traditional culture-dependent methods to quantify and identify airborne micro-organisms are limited by different factors (short-duration sampling times, inability to enumerate non-culturable or non-viable bacteria). Consequently, the assessment of bioaerosols is often underestimated. To overcome this problem, the real-time quantitative polymerase chain reaction (real-time Q-PCR) has been used to quantify bacteria in environmental samples. The aim of this study was to evaluate the performance of a real-time Q-PCR method to quantify the bacterial load in indoor air of poultry houses and to compare it with another non-culture-dependent method: epifluorescence microscopy.

METHODS: The study was done in one chicken house and two turkeys houses. Four methods to quantify the bacterial load were tested, two non-culture-dependent methods and two culture-dependent methods: 1) Q-PCR, 2) DAPI staining and counting with epifluorescence microscopy, 3) sampling with an impinger followed by culture and 4) direct impaction on culture plates. For the Q-PCR and DAPI methods, bacteria were sampled during 3-4 hours respectively onto cellulose ester and polycarbonate filter using pocket pumps at a flow rate of 3.5l/min.

RESULTS: Impaction : due to the high number of bacteria in the air, the number of colonies was too high to be counted. Q-PCR: inside chickens house, mean +/- SD : $897x10^6 \pm 335x10^6$ equivalent cfu/m^3 and inside turkeys houses : $615x10^6 \pm 300x10^6$ equivalent cfu/m^3. DAPI staining and counting: inside chickens house : $582x10^6 \pm 510x10^6$ equivalent cfu/m^3 and inside turkeys houses, only one sample could be quantified with a value of $16x10^6$ equivalent cfu/m^3. Impinger and culture: inside chickens house, one value of $24x10^6$ cfu/m^3 and inside turkeys houses : $53x10^6 \pm 38x10^6$ cfu/m^3.

CONCLUSION: The results from both non-culture-dependent methods are comparable. When the impaction method is inadequate for high numbers of airborne bacteria and the value obtained with the impinger-culture method is between 10 and 20 fold lower. Real-time quantitative PCR showed his ability to estimate airborne bacterial load. It could be used in other environments to monitor bacterial load.

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