

## EXPOSURE OF WORKERS TO AIRBORNE MICROORGANISMS DURING CLEANING OF PIGEON FAECES POLLUTED BUILDINGS

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### Abstract

During cleaning procedures in rooms contaminated with pigeon faeces, extensive dust contaminated with various microorganisms can be aerosolised. In this study levels of airborne microorganisms were quantified and partly identified. Airborne culturable bacteria were collected using filtration samplers and impingers. The concentrations of airborne microorganisms on CASO and DG18 agar were generally high, up to  $10^7$  CFU  $m^{-3}$  air. Concentrations of representatives of *Enterobacteriaceae* were often found in a range of  $10^3$  CFU  $m^{-3}$  air. Highest concentrations were found in aerosols from fresh faeces. The amount of bacteria decreased with the age of the faeces. The same tendency was found for *Campylobacter* and yeast numbers. In general, the concentrations of thermophilic fungi were low. *Chlamydomphila psittaci* was detected only in some bioaerosols originated from fresh faeces.

### INTRODUCTION

Extensive accumulations of pigeon faeces is often observed in areas where these birds occur in large numbers. Pigeon faeces contains various clinically relevant bacteria, among them *Chlamydomphila psittaci*, *Campylobacter* spp., *Salmonella* spp. and yeasts like *Cryptococcus neoformans*. During cleaning procedures these organisms can be aerosolized and hence can be inhaled by workers. Therefore, employees who are cleaning, restoring or repairing bridges, fronts of buildings or lofts are often exposed to these microorganisms.

In a two year study the levels of airborne microorganisms in different buildings were quantified and partly identified during specific working conditions in order to make a risk assessment.

### MATERIALS AND METHODS

Airborne culturable microorganisms were collected at a height of 1.5 m during specific cleaning conditions using three sampling methods: filtration with MD8 air-sampler (Sartorius, Göttingen, Germany) operated at  $100 \text{ l min}^{-1}$  for 10 min and gelatine membrane filter (pore size  $3.0 \mu\text{m}$ ); filtration with personal air sampler PGP-GSP (GSA Messgerätebau, Neuss, Germany) operated at  $3.5 \text{ l min}^{-1}$  for 30 min and gelatine membrane filter (pore size  $3.0 \mu\text{m}$ ); and liquid impingement with an all-glass impinger (AGI) with 30-mm jet-to-bottom spacing (AGI-30; Zinsser Analytic, Frankfurt, Germany) operated at  $12.7 \text{ l min}^{-1}$  for 30 min, each filled with 50 ml of sterile 0.9% w/v NaCl-solution. All samples were analysed within 24 hr according to a standardize bioaerosol collection method of a committee of the German Ministry of Labour (Technical standard TRBA 430). For indirect processing, each of the filters were dissolved in 10 ml of 0.9% NaCl-solution, containing 0.01% Tween-80 at pH 7. Impinger solutions could be used directly. For

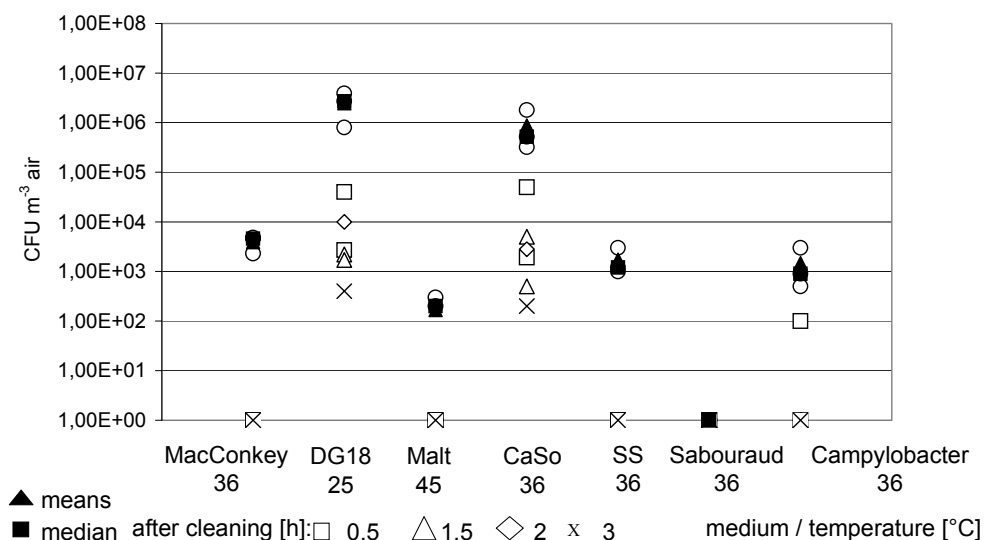
homogenisation the solutions were shaken for 15 min at 35 °C until they became clear. After serial dilutions, selective agars for *Enterobacteriaceae* (Salmonella-Shigella- and MacConkey No.3, both incubated at 36 °C), *Campylobacter* (Campylobacter-selective-agar, incubated at 36 °C by using Anaerocult® for reduction of O<sub>2</sub> and enrichment of CO<sub>2</sub>), thermophilic moulds (malt-extract with chloramphenicol and oxytetracycline, incubated at 45 °C), xerophilic moulds (Dichloran-Glycerol (DG 18) with chloramphenicol and oxytetracycline, incubated at 25 °C), yeasts (Sabouraud, incubated at 36 °C), and "total counts" (CASO, incubated at 36 °C) were inoculated in three replicates with 0.1 ml. Numbers of grown colonies were counted and concentrations of microorganisms were calculated as a mean of the three replicates as colony-forming units (cfu) m<sup>-3</sup> air.

Selected samples were studied for the presence of *Chlamydomypha*. Suspensions were inoculated to tissue cultures (BGM-Nonlayer), transferred and subsequently investigated in a fluorescence microscope with genus-specific monoclonal FITC-marked antibodies. In addition, the presence of *Chlamydomypha psittaci*-DNA was studied using multiplex-PCR.

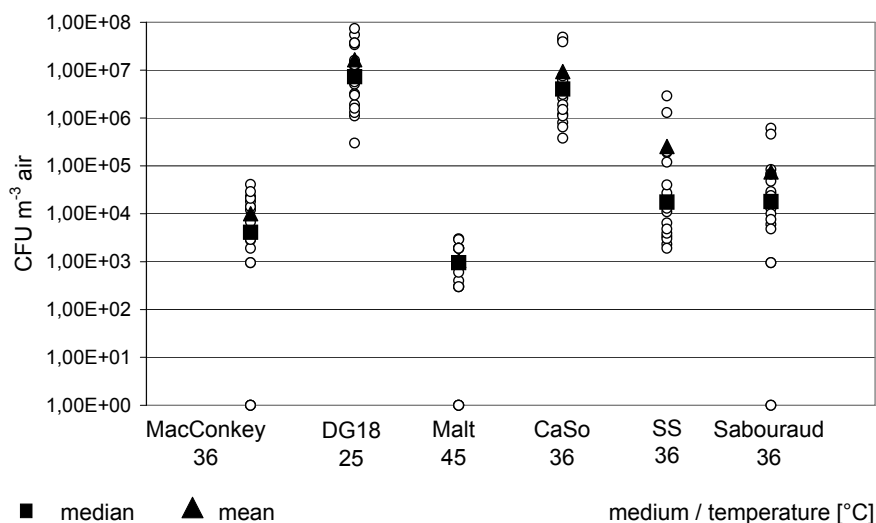
## RESULTS AND DISCUSSION

The results obtained for three of eight working places are shown in Figures 1 to 3. Overall the following highest concentrations of airborne microorganisms were measured [ranges of cfu m<sup>-3</sup>]: CASO: 10<sup>7</sup>; DG-18: 10<sup>7</sup>; maltextract: 10<sup>3</sup>; SS: 10<sup>5</sup>; MacConkey: 10<sup>4</sup>; *Campylobacter*: 10<sup>3</sup>; Sabouraud: 10<sup>4</sup>. Generally, concentrations of airborne microorganisms on CASO and DG-18 agar were high. Concentrations of representatives of *Enterobacteriaceae* were often found in a range of 10<sup>3</sup> CFU m<sup>-3</sup> air. These gram-negative bacteria are very sensitive to environmental conditions so it is not surprising to find their highest concentrations in aerosols from fresh faeces. Therefore, the amount of bacteria decreased with the age of the faeces. The same tendency was found for *Campylobacter* and yeast numbers. Concentrations of thermophilic fungi were generally low. The replication of thermophilic organisms depends on temperatures over 40 °C which could not be expected in the examined buildings of this study. *Chlamydomypha psittaci* was detected only in some bioaerosols originated from fresh faeces. The very high concentrations on a loft measured 9 month after cleaning (fig. 1) were remarkable. This results show, that even after a deposition of some month microorganisms can occur in relevant amounts.

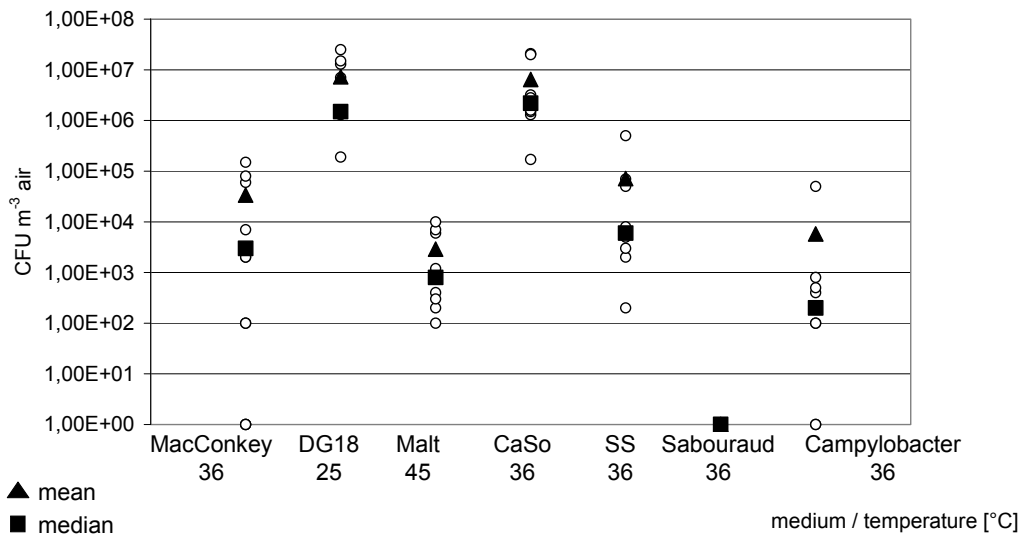
Bacteria cultivated on MacConkey- and Salmonella-Shigella-agar were mainly assigned to risk group 2 and avian strains of *Chlamydomypha psittaci* in risk group 3. Dependent on extent and age of pollution as well as type of the cleaning process there is a potential endangering of man. Besides usual hygiene we recommend specific personal safety equipment including breathing mask.



**Figure 1.** Concentrations of airborne microorganisms measured during simulated cleaning procedures on a loft. At the beginning of redevelopment faeces, nests, plumes and carcasses of pigeons were found. There were no pigeons on the loft for 9 month between cleaning and measurement. Shown are means, medians and concentrations at different times after the cleaning. *Chl. psittaci* was detected in 2 of 8 samples.



**Figure 2.** Concentrations of airborne microorganisms measured during cleaning procedures in a closed room under a bridge. At the beginning of cleaning there were a lot of pigeons, nests, eggs, plumes, carcasses and skeletons inside. The floor was covered with Faeces in a high of 10 cm. Cleaning was done by using broom and shovel. Shown are highest concentrations of 20 samples, means and medians. *Chl. psittaci* was detected in 3 of 5 samples.



**Figure 3.** Concentrations of airborne microorganisms measured during cleaning procedures on a loft with broom and shovel. The floor was covered with faeces in an high of 1-2 cm. At the beginning of cleaning there were some pigeons inside. *Chl. psittaci* was detected in none of 4 samples.

### Acknowledgement

The investigations were supported by the Tiefbau-Berufsgenossenschaft, Munich, Germany.

### REFERENCES

TRBA - Technische Regel für Biologische Arbeitsstoffe 430 "Verfahren zur Bestimmung der Schimmelpilzkonzentration in der Luft am Arbeitsplatz". Bundesarbeitsblatt (2001), 8, S. 79-83.