Evaluation of the performance of the Eudemon International Freshlight CFL

Test 2 – Bench Scale Agar Plate Test

A report prepared by

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Objectives of the study

The aim of the experiments was to determine the presence if any of a biocidal effect of the Eudemon International Freshlight CFL (lamps) when used against Staphylococcus aureus. The experiment was carried out on static agar plates to eliminate the presence of deposition of electrostatic precipitation as a removal mechanism. Therefore any reduction in the number of colonies growing on the gar plates can be attributed to some kind of biocidal effect.

Experimental Methodology

The experiment was carried out in an unventilated microbiological cabinet located in the Class 2 microbiology laboratory at the University of Leeds. A single lamp was mounted into a standard desk lamp and placed into the centre of the cabinet and switched on. The ion counter was also placed into the cabinet to monitor the negative ion concentrations during the experiment.

A total of 30 sterile agar plates were inoculated with an aliquot of Staphylococcus aureus culture such that after incubation there would be approximately 200-300 colonies on each plate. The first five plates (1-5) were set aside as the control plates and were not exposed in the microbiological cabinet. The remaining 25 plates were placed into the cabinet close to the lamp and the timer was started. After 1 minute (6-10), 5 minutes (11-15), 10 minutes (16-20), 15 minutes (21-25) and 30 minutes (26-30) five plates were removed.

The agar plates were incubated at 37°C for 24 hours after which the number of colonies on each plate were counted. Means were taken of each set of five plates to determine the mean control concentration with no exposure and after 1, 5, 10, 15 and 30 minutes exposure. This allowed the mean reduction in concentration to be calculated and used to give an indication as to the efficacy of the lamp.

In order to determine the statistical significance of the results t-tests was carried out on the data sets. The purpose of the test is to determine whether the means of the data sets are statistically different from each other. The test yields a p-value and the smaller the p-value the less likely the difference between the two data sets is the result of chance.

Results and Discussion

The ion counter was placed into the cabinet in order to measure the negative ion concentrations during the experiment. However when the lamp was switched on the negative ion count rose very quickly and went above the range of the ion counter. The maximum reading noted by the ion counter was 1.2 million ions/cc. Therefore it is clear that the lamp was capable of generating significant number of negative ions within the small space in which the test was undertaken.

Figure 1 shows the mean number of colonies on each of the sets of five plates with and without exposure to the lamp in the cabinet during test 1. It is clear that the mean count did not vary significantly from the control set and the exposed plates and that there appeared to be little effect from increased exposure time up to 30 minutes.

The percent reduction in the number of bacteria as indicated by the number of colonies on the plates is extremely small with only 3.4% 2.8% and 1.5% reduction at 1, 5 and 10 minutes respectively. The figures improved slightly at 15 and 30 minutes with 6.3% and 8.1% respectively.

The results from this test would suggest that although high concentrations of negative ions were generated by the lamp this had little effect on the growth of *S. aureus* on the agar plates. Given the nature of the test one would deduce that in this case at exposure times up to 30 minutes the negative ions had little biocidal effect on *S. aureus*.

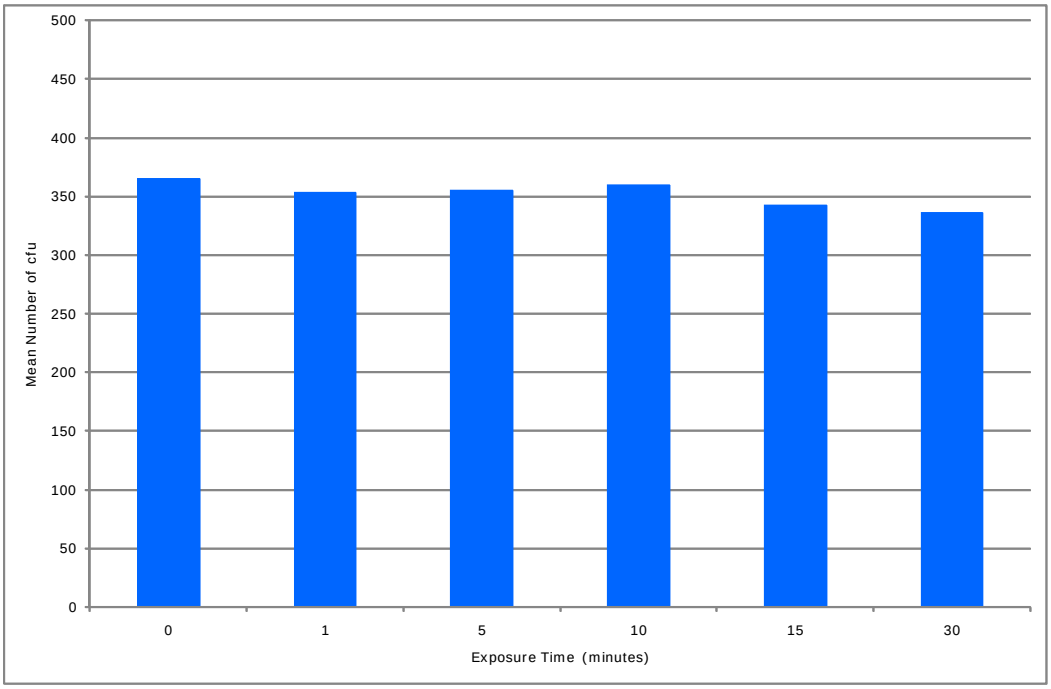

Figure 1 Effect of the lamp on the concentration of *S. aureus* Test 1

The test was then repeated with much longer residence times within the cabinet and this data can be seen in Figure 2. It can be seen that there is a gradual reduction in the concentration of *S. aureus* over time and table 1 shows the percentage reduction in S. aureus from the data generated from both tests.

It is clear that at relatively low exposure times of below an hour the biocidal effect of the ions is relatively low. However if the exposure time is increased then the biocidal effect also increases with up to 24% after 5 hours.

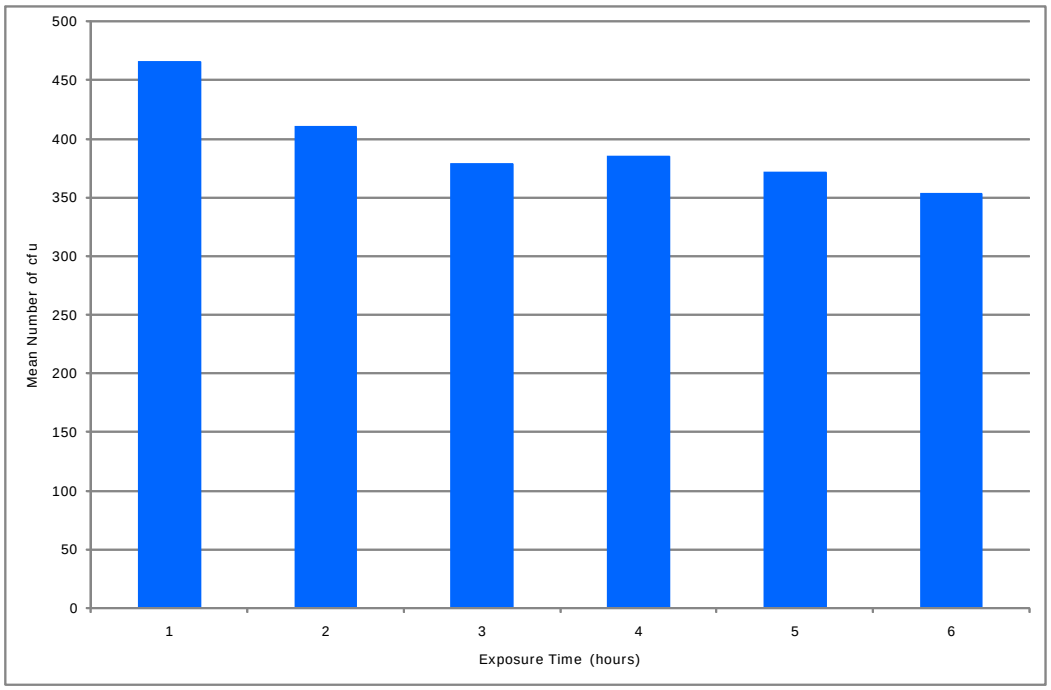

Figure 2 Effect of the lamp on the concentration of *S. aureus* Test 2

Table 1 and Figure 3 show the combined data from the two bench scale tests and the data is presented in the form of a percent reduction in the number of *S. aureus*.

Table 1 Percent reduction in *S. aureus*

Exposure Time	*Percent reduction*
1 minute	3.4
5 minutes	2.8
10 minutes	1.5
15 minutes	6.3
30 minutes	8.1
1 hour	11.7
2 hours	18.5
3 hours	17.3
4 hours	20.2
5 hours	24.0

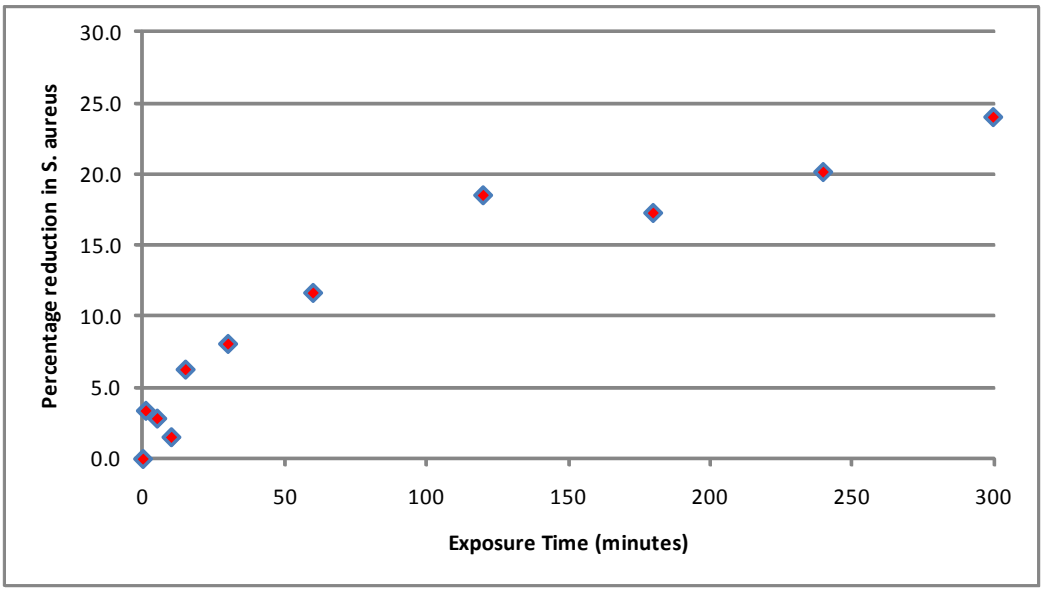

Figure 3 The effect of Exposure time on the percent reduction in *S. aureus*

Conclusions

The overall conclusions from the experiments carried out can be summarized as follows:

- A single lamp is capable of producing extremely high concentrations of negative ions within a small space
- At exposure times below an hour the negative ions had little effect on the growth/viability of *Staphylococcus aureus* however by increasing the exposure time significantly the biocidal effect of the ions become apparent.
- It would appear from the combined data that the rate of reduction in the number of *S. aureus* over time is still increasing up to 5 hours.

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Impact from the IonFlow Surface air purifier on mold concentrations in the office on 12 and 13 september 2009

T A S K D E F I N I T I O N

A) Determine if molds are present.
B) Identification of available molds.
C) Find out if the mold concentration can be reduced by using the IonFlow Surface air purifier.

A microbial reference measurement (accomplished with a microbial particle sampler) was performed just before turning on the air purifier in the office.

D E C L A R A T I O N

A1) The office has been intensivly ventilated one hour before the air purifier was turned on.
A2) Ther was no visible mold contamination in the office.
A3) Molds could not been smelled.

S A M P L I N G

Sampling procedure

- The air sampling is performed according the DIN ISO 16000-16 standards.
- Impactor methode
  The microbial sampling has been done with an impactor (MBASS 30) of the company Holbach.
- The impactor MBASS 30 is equipped with a jet classification stage LKS30.
  Serial number of the impactor: 52M0078.
- Air sampling volume: 100 litre per agar plate.
- Used agar plates: the qualified medium to verify indoor molds is the DG18 agar (Dichloran-Glycerin).

The impactor stage LKS30 is designed to detect air cultivable spores.
Sampling incidents or sample interruptions did not occur.
5 seconds waiting time has been programmed prior to start the air sampling.
The microbial particle sampler was placed in the middle of the office on a height of 135 cm. The surface of the office is 14 m². The volume is 35 m³.

V A L I D A T I O N O F T H E L A B O R A T O R Y A N A L Y S I S

Laboratory analysis, methode:
The collected Dichloran-Glycerin-(DG 18) agar plates were incubated at 24°C ± 1°C .
After 2,3 and 5 days the agar plates were analysed. The colony count was determined and they were differentiated.

Foilcontact preparations were made, stained with a blue lactophenol solution and microscopical analyzed.

RESULTS OF THE LABORATORY ANALYSES

12 September 2009: Mold reducement after **one** hour IonFlow operation.

Sample: 1 (after ventilation) **and** **sample 2 (after 1 hour operation)**

DG 18 24°C sample 1

air purifier off
46 colonies/agar plate

particles/litre in the air(> 0,5 µm) 12.523

DG 18 24°C sample 2

air cleaner on
16 colonies/agar plate

particles/litre in the air(> 0,5 µm) 5.311

13.September 2009: Mold reducement after **three** hours IonFlow operation.

Sample: 1 (after ventilation) **and** **sample 2 (after 3 hours operation)**

DG 18 24°C sample 3

air purifier off
42 colonies/agar plate

particles/litre in the air(> 0,5 µm) 3.831

DG 18 24°C sample 4

air cleaner on
5 colonies/agar plate

particles/litre in the air(> 0,5 µm) 1.060

S U M M A R Y

65% of the existing molds and spores are eliminated after one hour IonFlow air purifier operation.
The particles in the air are reduced by 57% in one hour.

88% of the existing molds and spores are eliminated during IonFlow air purifier operation after three hours.
The particles in the air are reduced by 72% within three hours.

The IonFlow air purifier could eliminate the molds and the spores very good in a short period of time.

R. Mier.

Forstern, 26 november 2009