UVD ROBOTS®

CLINICAL STUDIES

Acinetobacter baumannii

report id: uvdr-ict/ab

ASSESSMENT OF UVD ROBOT AGAINST REDUCTION OF MULTI DRUG RESISTANT *ACINETOBACTER BAUMANII* ON SURFACES

SUMMARY

The UVD robotic device was placed in a room containing two boards to create shadowed areas. The robot moved in front, between and behind the boards covering all areas of shadowing. Coupons containing a preset number of organisms were placed in container in two chosen positions with differing levels of shadowing and exposed for different time periods. The numbers of organisms remaining after the test period were counted and compared to the control and log reduction calculated.

The UVD Robot effected a greater than four log reduction within three minutes. *Acinetobacter baumanni* showed a greater than 6 and 7 log reduction (respectively) within three minutes.

1.0 INTRODUCTION

The electromagnetic spectrum is divided into seven regions ordered by decreasing wavelengths and increasing energy and frequency. These are radio waves, microwaves, infrared (IR) visible light, ultra violet (UV), X-rays and gamma rays. Ultra violet light falls in the range between visible light and X-rays. It can be subdivided into three sub-bands namely UV-A (315nm-400nm), UV-B (280-315nm) and UV-C (180-280nm).

UV radiation (photons) has sufficient energies to break chemical bonds so can be useful in chemical processing but it can also cause severe damage to materials and cellular tissues.

Most natural UV energy comes from the sun with 10% of sunlight being attributed to UV. 95% is UV-A and 5% UV-B. There is no measurable UV-C energy from solar radiation on the earths' surface because ozone, oxygen and water vapour absorb it.

UV-C can be produced artificially using lamps (usually vaporized mercury or other gas) that emit this radiation at a particular wavelength (254nm). Cells absorb this UV radiation through photons which cause ionisation of cellular substances including DNA. UV-C breaks molecular bonds within the DNA resulting in thymine dimers, which disrupts the structure and results in cell death for the microorganism.

UV has been used for many years within industrial, laboratory and medical settings as a surface disinfectant. This means UV-C has a huge potential as a disinfection process, especially in the healthcare environment as it kills the microorganisms on surfaces and in the air through DNA disruption and it does this very rapidly. Using UV-C as a final disinfection process post cleaning will reduce the risk of acquiring healthcare associated infections and hopefully reduce the need for antibiotics.

2.0 METHOD

2.1 Organisms used in the study

Acinetobacter baumanii (NCTC 12156)

2.2. Preparation of inoculum (with light soil ~ 0.3g/l bovine serum albumin [BSA]), for the organism

Inocula were prepared in-Maximum Recovery Diluent (MRD) (Lab M Ltd, LAB103) using log phase cultures of *Acinetobacter baumanii* (approximately 10^8 cfu/ml). As per EN 14561, 1ml of interfering substance (BSA - 3g/l)) and 9ml of test organism was mixed to ensure even dispersion.

Accurate viable counts were undertaken using a standard dilution method. The original inoculum for the organism was:
Acinetobacter baumannii = 2.58 x 10^8 cfu/ml

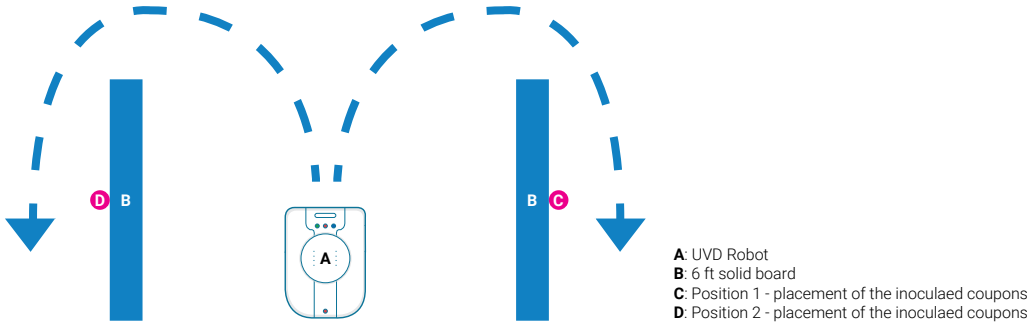
2.3 Preparation of the coupons

Stainless steel coupons (of the type and grade specified in BS EN 13697 – namely 1.5 mm depth / 20 mm diameter stainless steel, manufacturer code 304 2B) were inoculated with 50µl of the inoculum and dried for approximately 40 minutes at 36°C. The method was validated and showed a 1-2 log reduction of activity of *Acinetobacter baumanii* during the test period. This was due to organism dying on the coupons due to dessication. Therefore all log reductions were calculated against their own controls rather than to the original inoculum.

2.4 Effect of UVD robot on the viability of organisms

Dried suspensions of the organism on stainless steel coupons (held at a 45° angle) were placed in two positions within a designated area of 32m^2. Test coupons (exposed to UV-C) (n=3) and unexposed control coupons (n=3) were placed at the same locations. The unexposed control was prepared by wrapping with three layers of aluminium foil (to shield from UV- irradiation) around the petri dish containing the coupons. There was a separate petri dish for the organism under test (with an identical un-exposed control).

Figure 1A; Diagram of the room used



The robot moved into position one and the coupons were exposed for the required contact time. The robot then moved into position two and the coupons were exposed for the required amount of time. The robot moved autonomously between positions without any human interaction. The mapping was carried out prior to the testing by a member of the UVD Robot installation team. Melbec Microbiology Ltd prepared and processed the discs. See figure 1A.

An indicator was placed in the same area as the test coupons for comparison to the log reduction of the microorganism under test. The indicators turned bright pink indicating the UVD Robot was delivering over 1000 Joules per m^2 within the first run at five minutes. This was repeated for 10 minutes exposure.

2.5 Processing the coupons

On completion of each UV-disinfection cycle, the coupons were processed within the laboratory. Each coupon was aseptically transferred to 2 mL sterile Maximum Recovery Diluent (MRD) in a sterile bottle containing sterile glass beads. The MRD was vortexed mixed at full power for 30 seconds.

1ml was transferred to 9ml MRD, mixed and a ten-fold dilution series undertaken to determine an accurate viable count. 1 ml of each dilution was added to 12 ml molten Tryptone Soy Agar (Lab M Ltd, LAB011) as a pour plate and allowed to set. All plates were transferred to the relevant incubation conditions (37°C in air for 48 hrs for Acinetobacter baumanii. All testing was done in triplicate and the log reduction were calculated by comparison of the test mean log viable count and the control mean log viable count.

3.0 RESULTS

3.1 Antimicrobial effect of UV-C

There was a log reduction of organism numbers observed for the bacteria tested. There was high log reduction (> log 6 - > log7) for the Gram negative organism *Acinetobacter baumanii*) (Table 2) at 3 minutes.

Table 1; Log reduction at different time intervals.

Mean Log reduction	3 MIN	5 MIN	10 MIN
POSITION 1	7.11	>5.96*	>6.3*
POSITION 2	>7.41*	>5.74*	>6.3*

Key: * limit of detection

4.0 DISCUSSION

The log reduction was greater at 3 minutes exposure in *A. baumanii* showing a mean log reduction of log 7.26 and >log 6.

In future experiments, the coupons should be prepared just prior to the actual operation of the UVD Robot rather than preparing them all in advance. Although they were all used within a five hour period, there was still a 1-2 log reduction of numbers seen on the control coupons.

This was a snapshot study undertaken to determine whether an effective log reduction could be attained at a low time period. The bacteria was chosen: a Gram negative multi-antibiotic resistant strain, Acinetobacter baumanii, known to be causing problems in the UK in health care settings.

The bacteria was drastically reduced within a five minute exposure to UV-C via the UVD Robot. Shading was not an issue because the robot could move between positions and position itself so that sufficient UV-C was emitted in these areas.

5.0 REFERENCES

1. WHO Global list of antibiotic resistant bacteria- https://www.who.int/medicines/publications/WHO-PPL-Short_Summary_25Feb-ET_NM_WHO.pdf?ua=1

2. Literature Review and Practice Recommendations: Existing and emerging technologies used for decontamination of the healthcare environment. Airborne Hydrogen Peroxide. https://hpspubsrepo.blob.core.windows.net/hps-website/nss/1810/documents/1_hpv-lr-v1.1.pdf

Dated: 26th April 2019

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The UVD Robot is highly effective in the inactivation of harmful microorganisms and it is deployed by hospitals all over the world to protect vulnerable patients from hospital acquired infections. The clinical efficacy of the UVD Robot has been independently tested and validated at the following institutes:

Melbec Microbiology

DANISH TECHNOLOGICAL INSTITUTE

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