

DISINFECTANT EFFICACY OF ULTRAVIOLET LIGHT IRRADIATION IN AN AUTOMATED SYSTEMS FOR THE ASEPTIC COMPOUNDING

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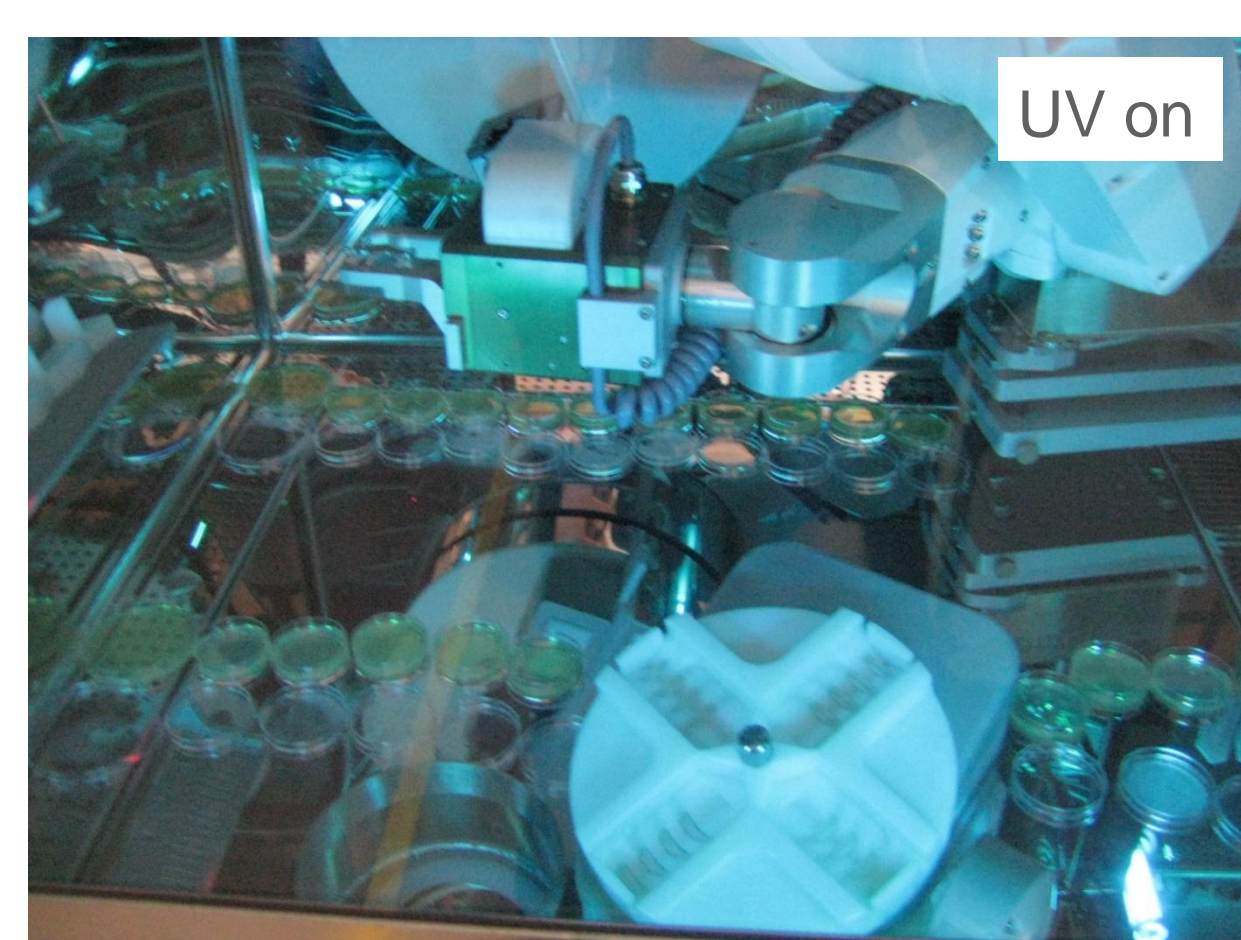
BACKGROUND AND PURPOSE

Ultraviolet (UV) light irradiation is used in a variety of applications, such as food, air and water purification. The mechanism of UV disinfection differs considerably from chemical disinfectants: UV is mutagenic to bacteria, viruses and other microorganisms by damaging nucleic acids and preventing replication. However, the effectiveness of UV disinfection depends on a number of factors: time of UV exposure; power of the UV source; presence of UV barriers like airborne particles; microorganism resistance. This study was aimed at assessing the effectiveness of UV disinfection into APOTECACHemo, the robot for the compounding of antitumoral drugs in use at the University Hospital of Ancona. The Killing rate (KR) and the optimal time of exposure were determined.

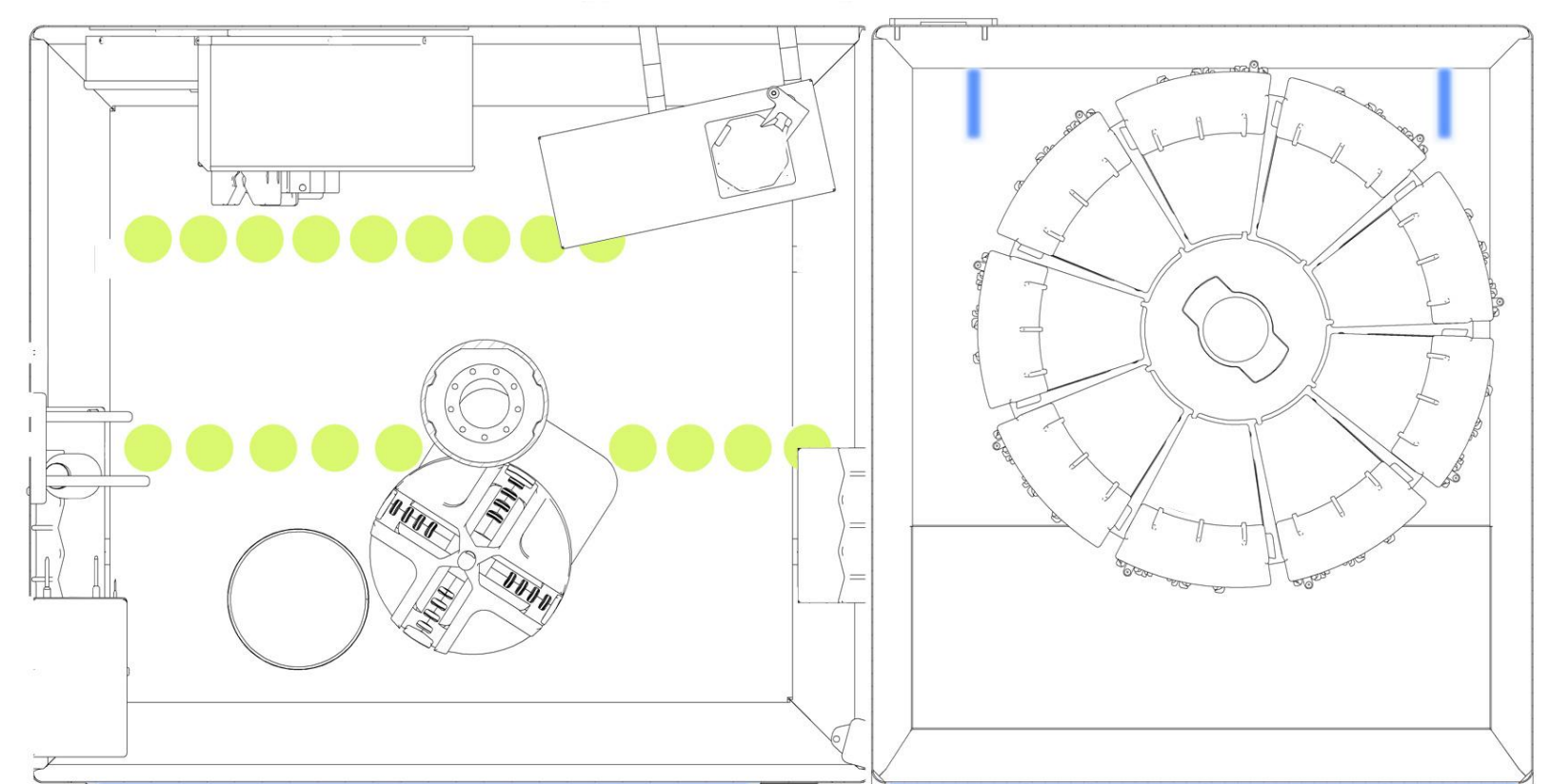


APOTECACHemo with UV lamp on.

MATERIAL AND METHOD



Location of the plates inside the compounding room of APOTECACHemo.



Drawing of the plates (green spots) and UV lamp (blue line) location inside APOTECACHemo.



Plates incubation at 37 C

5 different microorganisms were chosen for the study in order to cover all the most common families of microbes:

- *Candida albicans* (fungus);
- *Escherichia coli* (Gram negative bacterium);
- *Bacillus subtilis* (spring Gram positive bacterium);
- *Staphylococcus aureus* (Gram positive bacterium);
- *Pseudomonas aeruginosa* (Gram negative bacterium).

Different concentrations of each organism (from 10⁷ CFU/ml to 0.5 CFU/ml) were subjected to UV radiation for different exposure times, using the robot's UV equipment.^[1] The corresponding plates were located in two different positions inside the compounding room of APOTECACHemo in order to verify the influence of distance from UV source. After irradiation, the plates were incubated at 37 C for 24 hours and then the microbial load were evaluated.

The KR (logarithmic ratio between the concentration of microorganisms after and before irradiation) was plotted against the exposure time in order to graph the inactivation curves.

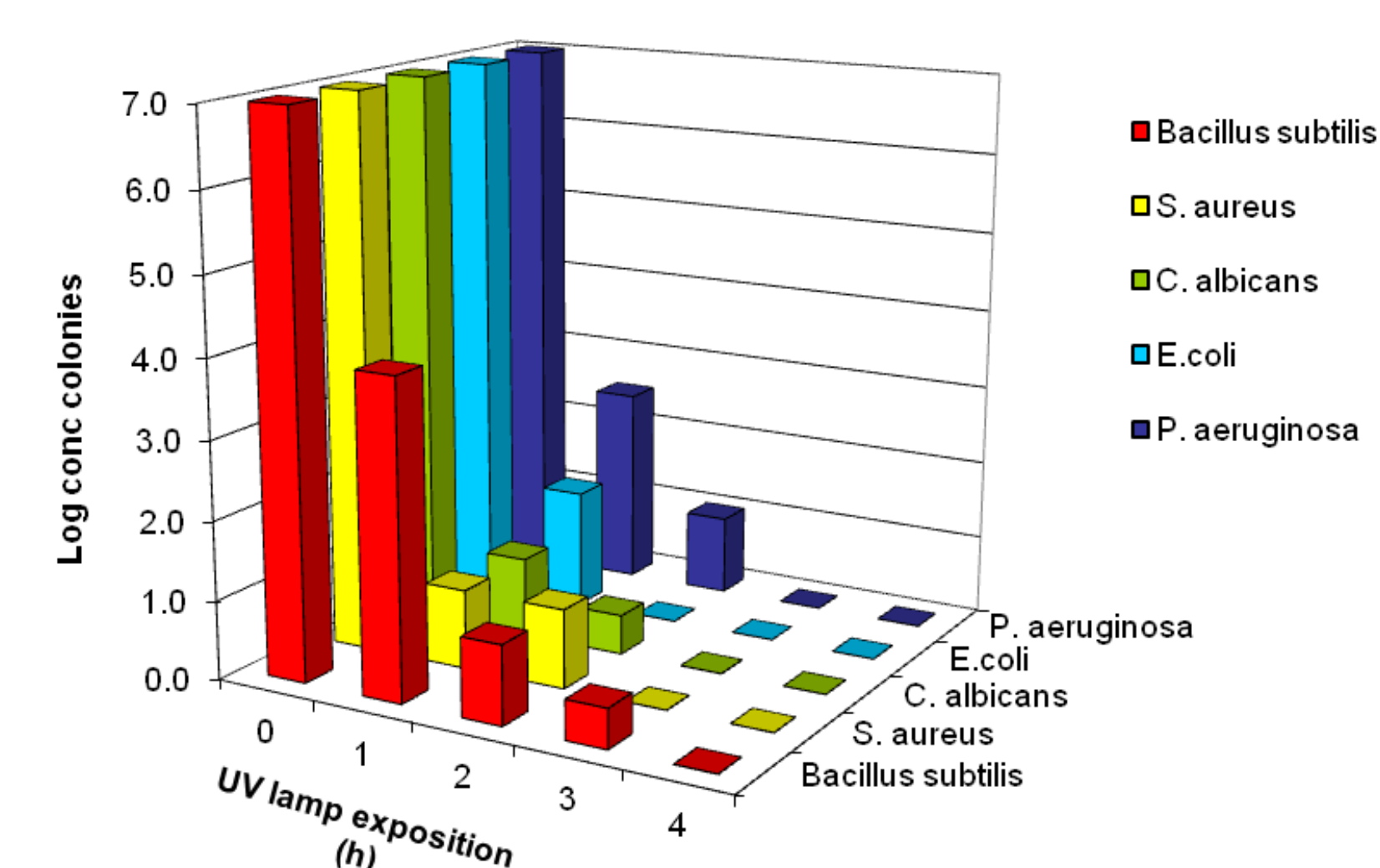
RESULTS

The UV radiation showed an unexpected high efficacy: a four-hour exposure recorded no microbial growth of all microorganisms at highest concentration.

Bacillus subtilis confirmed to be the strongest UV resistance microbe, indeed 4-hour exposure was necessary to kill 10⁷ CFU/ml. The less resistant microorganism was *Escherichia coli* with 2-hour UV irradiation.

While after three-hours exposure, no colonies of *S.aureus*, *C.albicans* and *Paeruginosa* were observed.

The plates location inside the system showed only a slight influence on the killing rate, likely thanks to the mirror effect of the stainless steel surfaces.



Microbial growth at different UV irradiation.

CONCLUSION

Different concentration of microorganism after 1 and 3 hours of UV lamp exposition.

Microorganisms	UV lamp exp. hours	CFU/ml								
		10 ⁷	10 ⁶	10 ⁵	10 ⁴	10 ³	10 ²	10 ¹	10 ⁰	
B.subtilis	1	TMTC	4	0	0	0	0	0	0	0
	3	10	0	0	0	0	0	0	0	0
S.aureus	1	TMTC	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
C.albicans	1	45	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
E.coli	1	TMTC	2	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
P.aeruginosa	1	TMTC	12	2	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0

The UV radiation is a fundamental step in the sanitization of workplaces. In fact, 4-hour exposure showed an effective sterilization (KR <7) outcome, also in case of very resistant microorganisms (*Bacillus subtilis*). However, taking into consideration a reasonable risk of microbial contamination into a cleanroom (10² CFU/m³ or 1 CFU/cm²),^[2] a day irradiation of 1 hour is sufficient to maintain the aseptic condition under ordinary condition.

References:

- [1] UV lamp: peak emission 254 nm; irradiance@1m 22mW/cm², radiant flux 2.4W.
[2] EU-GMP Annex 1, Manufacture of Sterile Medicinal Products.