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STERILIZATION USING GERMICIDAL UV LIGHT: A REVIEW

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ABSTRACT

Healthcare-associated infections (HAIs) can be initiated by microorganisms existing in common practice instruments producing major health diseases in the hospital environment. This work aimed to utilize the disinfection capacity of portable ultraviolet C equipment (UV Sanitizer Box and UV-C Sterilization Torch) developed to disinfect different objects. Pollution of the macro and microenvironment has been a source of worry for decades, and in recent years, the macro repercussions have been subjected to agreed-upon international standards aimed at reducing pollution. Furthermore, there are now national and international restrictions in place to limit the existence of microorganisms, particularly those that impact human, animal, and avian health in the environment and food chain. As a result of this concern, pollution reduction has become an industry, encompassing areas such as modifying technologies to minimize primary and secondary pollutants, as well as chemical, biological, and physical cleaning. Purification using ultraviolet (UV) C light (UV-C) is one of these approaches, and it has the advantage of being both efficient and, perhaps, the most energy-efficient technology.
In conclusion, UV-C Sanitizer Box and UV-C Sterilization Torch were effective disinfecting the most contaminated surfaces, being a promising alternative for disinfecting hospital materials and inanimate objects that cannot be immersed in liquid biocides, reducing the risk of pathogen transmission.

REVIEW ARTICLE

INTRODUCTION

Microorganisms are primitive forms of life. Their small size was not only the original rationale for classifying them distinct from animals and plants, but it is also relevant to their morphology, the activity and flexibility of their metabolism, and their ecological range. They include protozoa, bacteria, and molds.

Healthcare-associated infections (HAIs) lengthen hospital stays, resulting in long-term disability and increased expenses for health systems, patients, and their families, and result in avoidable deaths [1]. In addition, HAIs enhance the likelihood of choosing multidrug-resistant microbes. Gram-negative (Escherichia coli) and Gram-positive (Staphylococcus aureus) bacteria, spore-producing bacteria (Bacillus spp.), and yeasts are among the microorganisms that cause HAIs (Candida albicans) [1,2]. These pathogens can be spread by the hands of health care personnel and by patient-to-patient contact [3,4]. While medical equipment disinfection is common to practice, establishing hard surface disinfection measures for inanimate objects that come into contact with highly colonized areas of the

patient, such as hands, mouth, nose, and ears, that could be potential sources of HAIs and community infections, could be critical. Routine chemical and physical cleaning methods have been established to prevent bacteria colonization and persistence on both fomites and hard surfaces [4]. Ethanol and other alcohols, as well as biguanides such as chlorhexidine, are commonly used to disinfect surfaces and prevent nosocomial infections in hospitals and labs. However, due to the possibility of material or electrical degradation, not all of the above-mentioned objects can be treated with chemical biocides [3,4]. Among physical techniques or no-touch technologies, ultraviolet C radiation (UVC) is commonly employed in cleaning materials and hospital wards, surgical rooms, and intensive care units (ICUs). DNA exposure to UVC inhibits cellular replications incest damages the cell by photohydration, photo splitting, photodimerization, and photo cross-linking [5]. Therefore, based on the UVC microbicide effect, a new portable, automated, easy to use and safe equipment, UV Sanitizer Box and Torch, has been designed for disinfecting inanimate objects and hospital devices setting that might function as fomites, such as phonendoscopes, thermometers, sphygmomanometers, otoscopes, and so on.

OBJECTIVE

This study aimed to utilize the capacity of UVC to disinfect different materials contaminated with HAI-associated microorganisms in comparison to ethanol and chlorhexidine. Apart from this, the other objective includes:

- To prevent microbial colonization and persistence on fomites and hard surfaces.
- Maximizes biosecurity protocols.
- Provide an effective disinfection operation where no other method exists.
- Chemical-free and rapid disinfection.

MATERIALS AND METHODS

TUV TL Mini lights are compact double-ended UVC (germicidal) lamps used in-home water and air disinfection systems. The small 16 mm diameter of the lamp allows for a small system design and design flexibility. TUV TL Mini lights deliver almost constant UV output over their entire lifetime, guaranteeing maximum disinfection security and system performance.

Product Data

Cap-Base	G5
Main Application	Disinfection
Useful Life (Nom)	11000 h
Color Code	TUV
Depreciation (lifetime)	15%
Power (Nom)	11.5 W
Lamp Current (Nom)	0.4 A
Voltage (Nom)	34 V
Hg Content	4.4 mg
UV-C radiation 100 hr.	2.6 W
Net Weight (Piece)	22.000 g
Remark	Use only in an enclosed environment that shields the user from the radiation.

UV Irradiance value

The irradiance E on a tiny surface in point P at a distance a from an ideal linear radiation source AB of length 1 is calculated as follows:

$$E = \frac{\Phi}{2\pi^2 l a}(2\alpha + \sin 2\alpha)$$

ϕ is the total radiation flux (in W). This formula is taken from H. Keitz, Light calculations and measurements, Philips

Technical Library, MacMillan and Co Ltd, 1971.

Effect of UV light acquaintance on different organisms

The distance from the UV source (UV Torch) was kept at 4 feet and the time of exposure was 1 minute. Two samples of dry yeast were taken. 1st sample was exposed to UV-C light and 2nd sample was left as it is. For 24 hours, the samples were kept at room temperature. All of the tests were performed three times, using the same outcomes and interpretations as in experiment one.

RESULTS

UVC has advantages over chlorinating techniques because it produces far fewer noxious by-products and is it unaffected by the temperature. Note that the latter comment refers to the radiation, not to the lamp, or its environment as described earlier. In humid air, or in a wet environment, microorganisms are considerably more difficult to destroy than in dry air. This is because they restrict the transmission of 254 nm light.

DISCUSSION AND CONCLUSION

In the present study, a simple model is described to check the surface inactivation of microbes exposed to UV-C light. The preliminary observations had suggested the germicidal UV Torch is good up to a distance of eight feet with an exposure time of 30 to 45 seconds. Sanitization through the UV-C box which has tubes fixed inside the box was found to be more efficient.

The maximum advantage of UV light disinfection is for places like hospitals, schools, colleges, and other public places. While recommending the use of UV light at an appropriate distance and for an appropriate time we wish to emphasize that standard safety guidelines need to be observed during usage of UV light.

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