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Short communication

Possibility of using ultraviolet radiation for disinfecting the novel COVID-19

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ABSTRACT

The world health organization (WHO) declared novel COVID-19 as a pandemic in March 2020 and as of now has infected hundreds of millions of people across the globe. Here in this report, we propose the importance of light-based technologies in disinfecting the novel COVID-19, present on the surface of phone, plastic surfaces, wallets, watches, cloths. This article identifies the benefits of repurposing ultraviolet light-based strategies to combat the emergence of COVID-19 pandemic. A possible design for the ultraviolet irradiation is also proposed and discussed in short.

1. Introduction and Background

In 1903, the Nobel Prize was awarded to Niels Finsen for discovering the significance of ultraviolet (UV) light in killing germs, thereby eventually disinfecting hospital rooms and other public spaces \cite{1}. Ultraviolet (UV) light has energy ranging from $3.0 \text{ eV}$ to $6.0 \text{ eV}$ and is currently frequently used to kill the bacteria which may be present in the water in most of the water purifiers. In fact, the same methodology has been previously applied to inactivate viruses such as SARS \cite{2}, nuclear polyhedrosis virus of Tvicoplusia \cite{3}, infectious nucleic acid from tobacco mosaic virus \cite{4} etc. For this reason, UV lamps are often called "germicidal" lamps. It is well established that UV radiation can destroy the outer protein coating of the SARS-Coronavirus, which is unlike virus from the current COVID-19 virus, which was first reported in December 2019 and then characterized as a pandemic by the WHO on March 11, 2020. Since the pre-antibiotic era, the light-based germ inactivation strategies have been extensively used to prevent infections \cite{2}. It is known that the high energy UV light is absorbed by the RNA and DNA bases, and lead to the photochemical fusion of two adjacent pyrimidine into covalently linked dimers, which then become non-pairing bases \cite{5}. The low energy UV can cause pyrimidine the induction of dimers, and lead to the additional genetic destruction through the production of reactive oxygen species, which cause oxidation of bases and strand breaks \cite{6}. The most commonly used UV sources for germicidal applications are mercury vapor arc lamp and xenon lamp, which emits the broad UV spectrum. It is important to note that direct exposure these lamps for germicidal applications is not possible in public space due to health hazard, both to the eyes and skin. However, UV light exposure can be effective against different strains of airborne viruses such as COVID-19 on the electronic devices and personal protective equipment (PPE) kits. However, each light based inactivation strategy has its pros and cons which should be carefully considered in designing a new microbial control strategy.

1.1. Goal and scope of the study

The role and availability of PPE kits is an important factor in combating the COVID-19 virus. The necessities of PPE kits have increased exponentially, as more and more countries are facing this pandemic, which has created a temporary shortage of PPE kits in many developing countries. This shortage has affected the morale of corona warriors, as more than 25k health workers have been infected from this virus. On the same time, if the used PPE kits were not scientifically handled and disposed, it will impose a threat to terrestrial, human health and marine ecosystems. Therefore, it becomes vital to vet different options for PPE kits disposal or its reuse, to promote environmentally sound management of waste. Here, we report the challenges in ensuring adequate availability and consistent use of PPE in developing countries. In this aspect by shining the high intensity UV light on cloths, PPE kits, switched off electronic devices such as mobile phone, electronic
watches, keys, plastic materials can be beneficial to disinfect the novel corona virus. The beauty of this idea lies in the fact that it may be an effective approach to dispose and reuse the PPE kits, which is really a big challenge in front of all countries.

1.2. Proposed design

As discussed in the earlier section that UV radiation is categorized into several energy ranging from 3.0 eV to 6.0 eV and can considered as "germicidal UV". This absorbed UV energy can disinfects including pyrimidine dimers, which can prevent the expression of necessary proteins, resulting in the death or inactivation of the organism. Therefore, taking these aspects in mind we have proposed the design of UV germicidal chamber as depicted in the Fig. 1. We propose the array of UV lights at the center (Xenon lamp) of aluminum cylindrical chamber. The internal surface of the cylinder must be polished to make the surface as highly reflecting surface. The devices to be disinfected may be suspended as shown in Fig. 1. The direct light from UV source, multiple reflection from the inner surface of aluminum cylindrical chamber and long exposure time may lead to the inactivation of novel COVID-19.

The effectiveness of germicidal UV depends on the exposure time, wavelength of the UV radiation, a microorganism’s ability to withstand UV during its exposure and the presence of particles that can protect the microorganisms from UV. It is worth noting here that in the proposed work, we have suggested the Xenon lamp source, which can produce the whole UV–vis spectrum (200 nm–800 nm) and can thereby more effective to inactivate the novel COVID-19 virus. Most of the UV lamps which are available in the market have cylindrical geometry and maximum power upto ~36 W. Thus, by considering the cylindrical geometry, the total amount of power at a distance R from the center of UV source varies as 1/2πh (h is height of cylindrical lamp), and the power received at point P which is 50 cm away from the for center of 36 wattage and 5 cm long cylindrical UV lamp will be very close to 0.2 W. Therefore, very good quality aluminum high reflecting surfaces and exposure time of nearly 40 min (considering statistical effects) might be useful to completely deactivate the activity of this novel COVID-19 virus.

2. Our hypothesis/suggestion

In the fight against novel COVID-19 pandemic, an old weapon i.e. UV radiations may have re-emerged. The UV radiations may have a potential to disinfect the novel corona virus. The challenges in ensuring adequate availability of PPE kits may be resolved by shining the high intensity UV light on used cloths and PPE kits.

Declaration of Competing Interest

The authors report no declarations of interest.

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