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Mini Review

Use of Ultraviolet Radiation for Air Disinfection to Prevent Coronavirus Covid 19

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Abstract

An outbreak of the COVID-19 pandemic around the world poses a significant threat to people around the world. Therefore, various methods aimed at reducing this threat to humans have the right to test their effectiveness and implementation to protect against COVID 19. One such method may be a method of reducing the activity or complete neutralization of the virus in the air, through which it is transmitted from person to person. destructive short-wave ultraviolet radiation.

Keywords: *Ultraviolet Radiation; Coronavirus Covid 19; Disease Prevention*

"Coronavirus COVID 19 is one of the most dangerous types of viruses, a representative of one of the smallest species of biological life on Earth".

Introduction

The efficiency of photons of ultraviolet radiation on biological organisms is based on chemical changes of biological molecules of irradiated structures, due to which ultraviolet radiation has a wide range of action on all microorganisms, including bacteria, viruses, spores, fungi and more. This phenomenon is called bactericidal action, which is manifested in the death of all types of microorganisms, which is associated with irreversible damage to the structure of their DNA. The process begins with the absorption of UV photons in the microorganism [3]. In the action of short-wave radiation on a living organism, the greatest interest is the effect of ultraviolet rays on biopolymers - proteins and nucleic acids. Molecules of biopolymers contain ring groups of molecules containing carbon and nitrogen, which intensively absorb radiation with a wavelength of 250 - 280 nm. The absorbed energy can migrate along the chain of atoms within the molecule without significant loss until it reaches the weak bonds between the atoms and breaks that bond. During this process, called photolysis, fragments of molecules are formed, which have a strong destructuring effect on the body. In addition to photolysis under the action of ultraviolet rays in biopolymers is denaturation. When irradiated with light of a certain wavelength, the electric charge of molecules decreases, they stick together and lose their activity - enzymatic, hormonal, antigenic, and others. The processes of photolysis and denaturation of proteins are parallel and independent of each other. They are caused by different ranges of radiation: rays 280 - 302 nm cause mainly photolysis and 250 - 265 nm - mainly denaturation. The combination of these processes determines the overall picture of the effects of ultraviolet rays on bacteria, cells and viruses. It is established that the most sensitive to the action of ultraviolet rays cell function - division. Irradiation at doses of 10 ÷ 15 J/m^2 causes the cessation of division of about 90% of bacterial cells. But the growth and viability of cells does not stop. Over time, their division is restored. To cause the death 90% of cells, inhibition of the synthesis of nucleic acids and proteins, the formation of mutations, it is necessary to increase the radiation dose to 15 ÷ 22 J/m^2. Ultraviolet rays cause changes in nucleic acids that affect the growth, division, heredity of cells, i.e. the main manifestations of life [3]. The significance of the mechanism of action on the nucleic acid is explained by the fact that each DNA molecule (deoxyribose nucleic acid) is unique. DNA is the hereditary memory of a cell. Its structure encrypts information about the structure and properties of all cellular proteins. If any protein is present in a living cell in the form of dozens and hundreds of identical molecules, the DNA stores information about the structure of the cell (virus) as a whole, about the nature and direction of metabolic processes in it. Therefore, disorders in the structure of DNA can be irreparable and lead to serious disruption of life.

Results of research

According to international terminology, radiation capable of destroying any pathogenic microorganisms is called herbicidal radiation, and capable of neutralizing only bacteria is called bactericidal radiation. In some countries, including Ukraine, the first term is not used, and in all cases the adjective "bactericidal" is used to neutralize pathogenic microorganisms. In viruses, lethal action is manifested in the loss of the ability to intracellular reproduction, and in other microorganisms - in cell death before the first division or most often in the first or subsequent generations (generations) [3]. As early as 1929, it was shown that the spectrum of lethality of microorganisms (Figure 1) coincides with the absorption spectrum of the cell as a whole and with the absorption spectrum of nucleic acids. Subsequently, this fact was confirmed by numerous experiments.

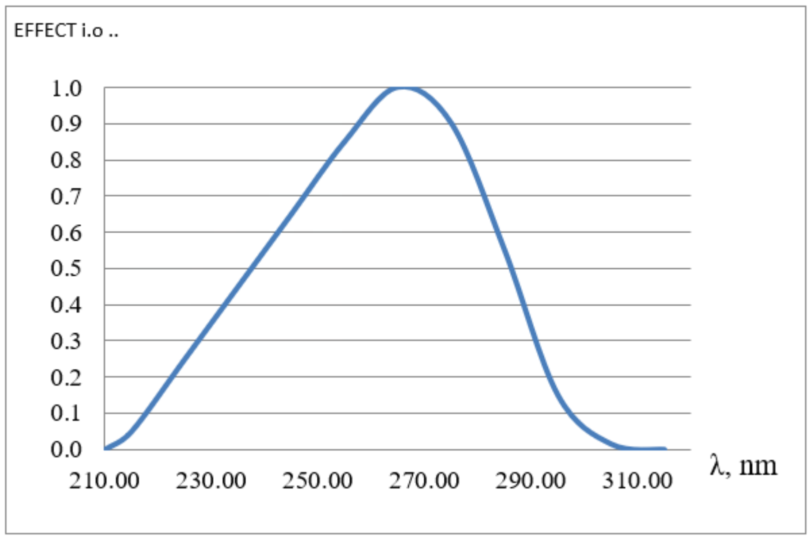

Figure 1: *Curve of efficiency of bactericidal action of UV radiation.*

According to the figure 1 is seen that the spectra of lethal effect have a pronounced maximum at 260 - 265 nm [1]. However, for individual organisms, "protein" spectra with a maximum at 280 nm and mixed spectra of lethal effect with maxima at 260 and 280 nm are also noted [6].

Table 1 summarizes the results of experimental studies of various scientists to determine the effectiveness of exposure (dose) of short-wave ultraviolet radiation of different types of bacteria and viruses.

Types of microorganisms and viruses	Doses, J / m^2, for bactericidal efficiency (at 90% of death)
Bacteria	
Staphylococcus aureus	49,5
Staphylococcus epidermidis	33
Staphylococcus haemolitucus	21
Staphylococcus viridans	20
Corynebakterium diphteria	34
Mycobacterium tuberculosis	54
Sarcina flava	197
Bacillus subtilis	120
Escherichia coli	30
Salmonella typhi	21
Shigella	16
Salmonella enteritidis	40
Salmonella typhimurium	80
Pseudomonas aeruginosa	55
Enterococcus	40
Viruses	
Influenza virus	36
Bacteriophage of *Escherichia coli*	36

Table 1: *Doses for bactericidal efficiency (at 90% of death) of Bacterias and viruses.*

Currently, disinfectant bactericidal ultraviolet installations have a large practice of use in operating rooms of hospitals. When calculating the mode of their operation use the initial values of the effective radiation dose according to the data in table 1.

When disinfecting the air, two types of disinfectant irradiators are used.

Open type: In such irradiators, ultraviolet radiation from the lamp acts directly on the air around the irradiator. Moreover, radiation with a wavelength of less than 254 nanometers ozonizes oxygen molecules, which further contributes to the death of viruses. Such irradiators can be used only without the presence of service personnel, which limits the effectiveness of such systems in a room where there are always many people.

Closed irradiators of recirculation type. In such systems, the air drawn in by the fan passes through the irradiation chamber, is exposed to direct UV radiation from the lamp and is released back into the room disinfected. A promising area of use of recirculating UV disinfection devices is the installation of filters for pre-filtration of air, i.e. bactericidal disinfection occurs in two successive stages, which complement each other. These two stages, which are physical methods, can be called complementary, because filtration successfully removes from the air microorganisms most resistant to UV radiation (spores, bacteria and mold), and UV disinfection effectively inactivates viruses that can pass through filters even high efficiency. The principle of operation of the proposed electrical system for bactericidal air disinfection is as follows: air, which is constantly removed from the room through the inlet, is supplied by a fan to the chamber, where under ultraviolet radiation is disinfected and enters the room, while ensuring uninterrupted recirculation.

Recirculators are an effective anti-epidemic and prophylactic agent. This equipment is operated both in the presence and in the absence of people, animals and plants [7-15].

Conclusion

1. When UV irradiation of viruses, bacteria and microorganisms there is an exponential dependence of reducing the number of living microorganisms on the dose during irradiation. Known results of studies with viruses and bacteria suggest that the virus COVID 19 will neutralize strong ultraviolet radiation with a wavelength of 250 - 280 nm.

2. In the process of irradiation of coronavirus COVID 19 the main characteristic of the efficiency of the process is the damaging effect on the biological structures of the virus (proteins and parts of DNA, RNA) photons of UV radiation of different energy and wavelength and therefore for the use of ultraviolet irradiators studies to determine the surface or volumetric dose of air.

Bibliography

1. Seliger HH and Elroy WD. “Light: Physical and biological action”. N.Y.: Academic Press (1965).
2. Acemi A., *et al.* “A preliminary investigation on developmental and biochemical responses of Amsonia orientalis to ultraviolet-C irradiation”. *Advances in Horticultural Science* 32.4 (2018): 563-568.
3. Gray NF. “Ultraviolet Disinfection”. Microbiology of Waterborne Diseases (Second Edition) (2014): 617-630.
4. Kowalski WJ. “Ultraviolet germicidal Irradiation Handbook. UVGI for air and Surface Disinfection”. Springer-Verlag Heidelberg (2009).
5. Bolton JR and Cotton CA. “The ultraviolet disinfection handbook”. American water works association (2008).
6. Von R Phillips. “Sources and Applications of Ultraviolet Radiation”. Academic Press, London (1983): 434.

7. Chervinsky LS. "Primary mechanism of action of optical radiation on living organisms". *International Journal of Biosensors and Bioelectronics* 4.4 (2018): 204.

8. Ananthaswany HN. "Ultraviolet light as a carcinogen". Chemical Carcinogens and Anticarcinogens. – Oxford 12 (1997): 255-279.

9. Artificial tanning devices: public health interventions to manage sunbeds. Geneva: World Health Organization (2017).

10. Joint market surveillance action on sunbeds and solarium services – Part 2. Brussels: Prosafe: Product Safety Enforcement Forum of Europe (2012).

11. James R Bolton and Christine A Cotton. "The Ultraviolet Disinfection Handbook". American Water Works Association, Denver (2012): 166.

12. Fridman A., *et al.* "Decreasing operating room contamination of surfaces and air with pulsed xenon ultraviolet disinfection". *American Journal of Infection Control* 41.6 (2013): 36.

13. Semenov A and G Kozhushko "Bactericidal irradiators for ultraviolet disinfection of indoor air". European Applied Sciences. Stuttgart, Germany 1.13 (2013): 226-228.

14. Stephen B. "Germicidal ultraviolet irradiation. Modern and effective methods to combat pathogenic microorganisms". *Ashrae Journal* 50.8 (2008): 18-20.

15. Semenov Anatoly., *et al.* "Ultraviolet disinfection of activated carbon and its use for microbiological decontamination". Green Chemistry and the Environmental: 257st American Chemical Society National Meeting and Exposition, Orlando, Florida (2019): 409.

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