International Journal of Scientific Advances
ISSN: 2708-7972
Volume: 3 | Issue: 6 | Nov - Dec 2022 Available Online: www.ijscia.com
DOI: 10.51542/ijscia.v3i6.3

# UV Disinfectant Médium

**Estefania Moreno Carreño[1*], Ernesto Mendoza Vázquez [2] and Moisés Sánchez Moredia[3]**

[1]Industrial maintenance engineering student,
Technological University of Tlaxcala, Tlaxcala, Mexico

[2]Automation department, Technological University of Tlaxcala, Tlaxcala, Mexico

3Lenguage department, Technological University of Tlaxcala, Tlaxcala, Mexico

E-mail: fanny2016mc@gmail.com; emendozavz@gmail.com;
moises.sanchez@uttlaxcala.edu.mx

*Corresponding author details: Estefania Moreno Carreño; fanny2016mc@gmail.com

## ABSTRACT

The objective was to design and create an airtight environment that disinfects objects and inactivates microorganisms with radiation, in addition to being easy to use and at a low cost. With a metallic structure, acrylic paint coatings, an acrylic sheet and a UV light lamp, which is controlled with a radiation sensor and another movement sensor. To be able to disinfect the interior of the box allowing to inactivate microorganisms at a low cost and easy handling. When using radiation as a disinfectant, microorganisms do not generate resistance and it is an easy- to-use method. The design was based on equipment used to disinfect, the design was carried out in design software, then an analysis of materials for its construction was carried out, taking into account radiation and other variables such as temperature. The results were the analysis of the correct function of the seals in the box, the power of the radiation to inactivate and the easy handling of the equipment.

***Keywords:*** Inexpensive; effective; disinfection

## INTRODUCTION

Throughout history there have been different types of disinfectant media, each with different applications, these are classified as two different; physical agents and chemical agents. The first focuses on heat and radiation, while the second onantiseptic solutions.

Sterilization is not something new these days, due to advances and uses in different fields, such as sanitization. UV rays are physical agents due to the radiation they emit and have been used as a sterilization method applied in different fields, they are used asa physical process with a germicidal effect. The radiation power is measured in different waves such as high, medium and short, in the prototype the length called "short wave" was used. It works by shining light on an object and microorganisms that absorb that light will take damage which destroys their genetic material (DNA or RNA) so that they are unable to reproduce and infect.

The efficient use of UV light as a disinfectant method may depend on certain factors, for example, the distance of the irradiated object, if the light is too far away it will not generate the disinfectant effect, but if the light is too close it could cause burns. Another element is the presence of shadows, since their presence willprevent the light from reaching all areas for proper disinfection. Finally, the exposure time where the lamps must remain on for a while to disinfect the area.

This project seeks to focus on the use of UV rays to disinfect areas of contaminating agents, since the investigation determined that this method is viable for the maintenance of biological crops.

A hermetic equipment was necessary for the project.As a result, a hermetic box was development. The boxworks by turning on some lamps inside it for a few minutes to inactivate harmful particles a then the lamps will be deactivated with the help of a timer. When the box area is disinfected you can work.

## THEORETICAL FRAMEWORK

In 1801, Johann Ritter observed chemical activity caused by some form of energy in the dark part of the solar spectrum, other than violet, which he called deoxy stars to distinguish them from Sir William Herschel's heat rays, as described above. Subsequently, the terms that are now accepted were coined: ultraviolet radiation for deoxygenated rays, and infrared thermal radiation. (Hockberger, 2002) [1] The discovery of ultraviolet (UV) radiation and its properties has been a gradual process involving scientists from all over the world for three centuries. Isaac Newton, a pioneer in the study of radiation and light, postulated the phenomenon of scattering in 1666 after a beam of light passed through a triangular glass prism. (Diffey, 2002) [2].

Ultraviolet radiation is non-ionizing radiation with wavelengths between 100 and 400 nm. There are three types: UV-A (315-400nm), UV-B (280-315nm), and UV-C (200-280nm). The maximum emission peak of UV-C radiation is 254 nm, and it has been shown to have the greatest bactericidal effect at this wavelength, which is why it has been extensively studied in various plant tissues. (Pastrana, et al., 2007) [3].

Ultraviolet light (UV) is a group of radiations of the electromagnetic spectrum with wavelengths between 150 and 400 nm divided and UV-C (below 280 nm). UV-C radiation is the most energetic part of the UV spectrum. It does not occur naturally in the biosphere but has been used artificially for its important bactericidal and antiseptic effects. (López, AG, & S del C, 2010) [4]. Ultraviolet (UV-C) is an alternative chemical disinfection technique used to reduce the growth of microorganisms in food. The UV-C application time is 1-5 minutes, a time that does not significantly increase the temperature of the fabric (1-3°C) and does not accelerate or alter the aging process of the product. The advantage is that it does not leave residues and does not affect the organoleptic properties (flavor and aroma) of the product. (Pastrana, y otros, 2007) [5].

By this, it means that the use of UV light, as the implemented disinfection tool for this project, has shown better effectiveness against other types of radiation.

Each microbial species has a characteristic level of resistance to ultraviolet light. This factor depends on the growth phase and the physiological state of the microbial cells. Comparing the resistance of vegetative cells of some bacterial species with that of other bacterial species, exposure to ultraviolet light has been shown to reduce the resistance of some species for more than five times longer than the time required for cell destruction in other species. cells. In general, the exposure time to destroy them does not vary from one species to another. The formation of capsules and the grouping of bacteria increases their resistance to ultraviolet radiation. Two to five times longer exposure times are required to kill microbial spores than to kill the corresponding vegetative cells. Yeasts are generally two to five times more resistant than bacteria, but some are easily killed. Molds are 10 to 50 times more resistant than bacteria, colored molds are more resistant than colorless ones, and spores are more resistant. (Ramos, Villarroel Millan, & Romero Gonzales, 2015) [6].

In this sense, based on the analyzes carried out on different organisms, it is verified that UV rays do not usually have the same effect on them. Thus, knowledge about certain organisms is crucial for their eradication. Well, the dosage of light in the environment depends on it. If these variables are for this not considered, at the end of the tests it could negatively affect the results. Consequently, it is important to take into account essential points such as the categories of light, exposure period, type of organism, and the distance of application of the rays for its correct function.

There is a class of microorganisms that can be used as a biological control for plant pathogens. Among the most important microorganisms are bacteria and fungi. The latter is mainly used to control an important group of soilborne pathogens. Some species and strains can produce bioactive metabolites that enhance their effects. In addition, some isolates fight against nematodes. (Vega & Fernández, 2001) [7].

**METHDOLOGY ELABORATION PROCEDURE**

***Design***

A drawing was made in the Solid Works program of how the prototype would look like, and the areas where the gloves, the switch, and the lamp would be placed.

The prototype had the following dimensions, in the back it measured 90 cm, with a width of 30 cm, height in the front area it measured 30 cm, in addition to this area the gloves were located and, finally, it would have a slope of 45° at the junction of the rear and front faces. With that angle, you could see things inside the box.

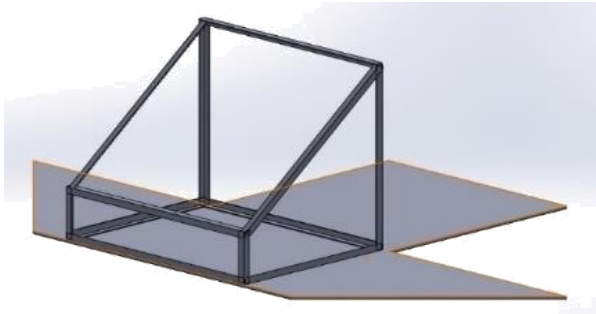

**FIGURE 1:** Drawing of the prototype in Solid Works.

***Build***

Materials that had radiation-resistant characteristics were chosen for the construction of the prototype. A 1-inch metal angle was used to make the base and support of the box, also a galvanized sheet was used for the shell of the back, base and sides.

Besides, it was added a white paint coating on the inside for prevent light absorption in the met and a black paint coating on the outside as protection. In the same way, an acrylic sheet was used to cover the front area and the lid, so it can be seen moving insidethe box. In the front area, two circular cuts were made, to which threaded bases were added to be ableto attach the gloves.

The design of the bases for the gloves allowed them to be put on or taken off easily. In addition, adding rubber to the top of the acrylic sheet would help to create an airtight space, since the rubber would prevent the passage of air into the box.

**FIGURE 2:** Final construction of the equipment.

***Control design***

The initial design was dangerous for the user because the lamp off button was on the top of the box, and this may cause burn. By implement a timer that deactivates the lamps, it will be possible to prevent the user from being directly exposed to light, thus avoiding accidents.

As a precautionary measure, in case the timer fails and does not inactivate the lamp, an ultrasonic sensor was added which, upon detecting movement inside the box, deactivated the lamp, thus avoiding unwanted mishaps.

Also, the implementation of a sensor that measures the radiation emitted by the lamp, since light control is important in order to not cause harm to the user, because high levels of radiation can be dangerous. With the help of a screen, the photons emitted by the lamp can be seen and the user will know if the radiated light is in the correct range, which is 4,43-12,40 units.

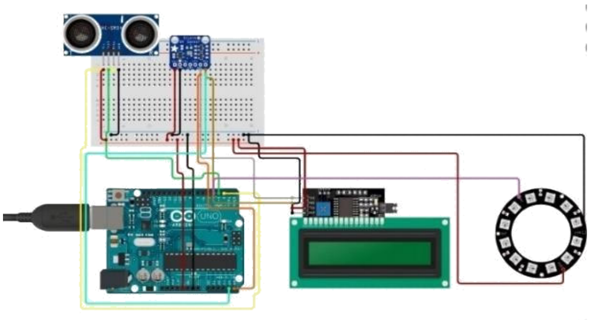

**FIGURE 3:** Sensor control diagram.

**PROCEDURE FOR USE THE DISINFECT BOX**

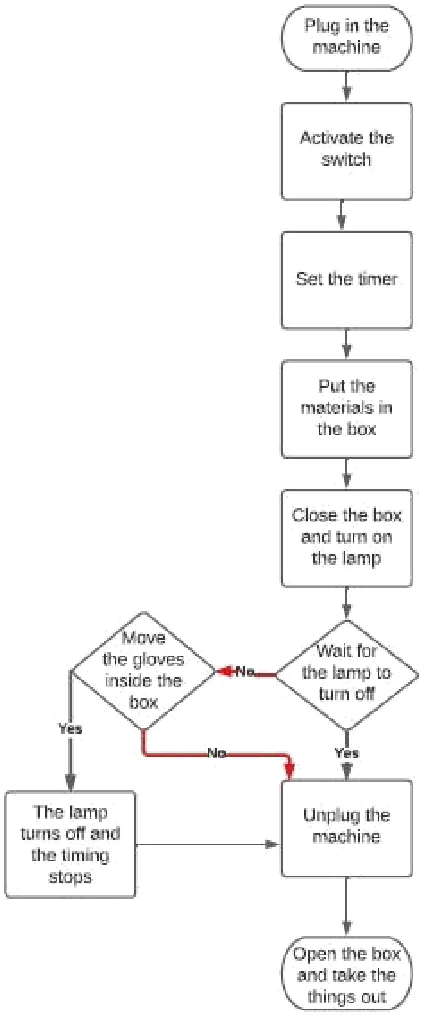


**FIGURE 4:** Process diagram of the use of the box.

**RESULT**

Starting from the initial objective, which was a disinfection box, it can be determined that the new design presents or improves compared to the previous one. These improvements refer to the implementation of white paint inside, the implementation of sensors, and the control of hermeticity in the box is described below.

In the first place, the previous design did not have adequate hermeticity since contamination problems were detected in the initial samples and this will be repaired by placing an automotive rubber seal in the area of the lid and sealing the cracks with cold silicone, thus preventing the passage of contaminants.

Another point found was that at the beginning a layer of paint was not placed causing the metal to absorb light, so it would lose irradiation efficiency, for this, a layer of white acrylic paint was placed inside, with this it will be repaired that no the effectiveness of the light would be lost and a better presentation would be obtained.

The implementation of the sensors as a precautionary measure for users made it possible to add a security point that allowed the lighting control of the lamp, thus guaranteeing greater security and confidence when using the equipment.

As the last point, negative control and positive control tests were performed. This refers to the fact that the negative control contained live microorganisms and was exposed to light to eliminate them and thus verify the efficacy of the radiation at different exposure times, those being 5, and 10 minutes. While the control was a medium without microorganisms that was left open for a long period inside the box to later check if there was contamination caused by cracks in the box or poor sealing in the lid.

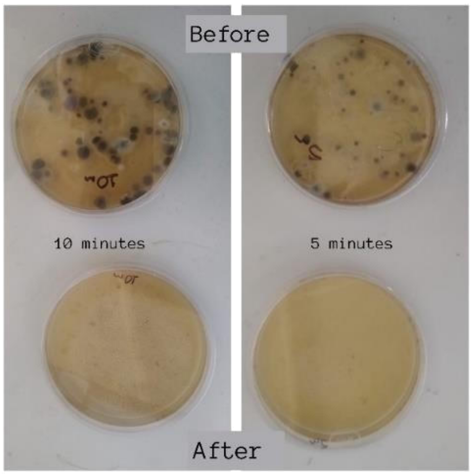


**FIGURE 5:** Microorganisms exposed to light.

At the end of the analysis, it was found that the most improved exposure time is 5 minutes, although it is a short period, it mostly removes contaminants effectively. If necessary, it can be irradiated for another 5 minutes, but only in isolated cases where they will have greater resistance. When performing the second analysis, no contaminating agents were found in the culture, resulting in the desired hermeticity, demonstrating that the box was sealed and the lid closed correctly.

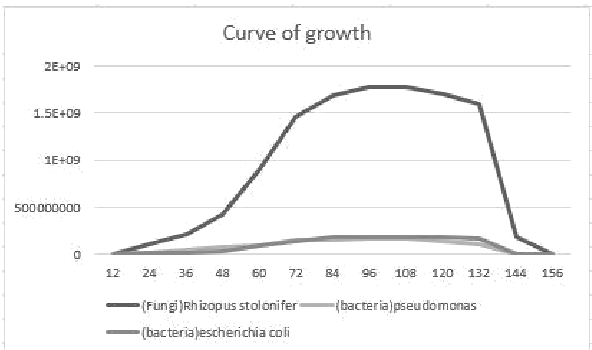


**FIGURE 6:** Curve of growth of microorganisms.

**CONCLUSIONS**

It was possible to obtain data to justify the theoretical research regarding the disinfection of samples according to the variability of time to light exposure, as well as to establish a security system with the help of sensors for the prevention of damage by UV light. and creating a proper seal.

The design and manufacture of this type of equipment will make it possible to work as an alternative way to replace large-sized and high-cost equipment that requires specific capabilities and skills for its handling, the design of this miniaturized equipment will allow easier handling and without so many capacities or theoretical knowledge about the equipment being this a simple but efficient versatile equipment.

The equipment allows us to work safely and easily, due to the adaptations that were made taking as a reference characteristics used in similar equipment, thus ending in equipment that is easily handled, without the need for specialized knowledge.

**REFERENCES**

[1] Diffey, B. L. (2002). Human exposure to solar ultraviolet radiation. Photochemistry and Photobiology, 3.

[2] Hockberger, P. E. (2002). A history of ultraviolet photobiology for humans, animals and microorganisms. Photochemistry and photobiology, 571.

[3] López, R., AG, Q., & S del C, R. (2010). Efecto de luz UV-C sobre las propiedades antioxidantes ycalidad sensorial de repollo mínimamente procesado. 101-108.

[4] M, D., Pastrana, R., A, A., & Bejar, G. (2007). EFECTOS BIOQUÍMICOS POSTCOSECHA DE LA IRRADIACIÓN UV-C EN FRUTAS Y HORTALIZAS. Revista Fitotecnia Mexicana, 59-64.

[5] Pastrana, R., M., D., Béjar, G., A, A., M, D., & Aguilar, G. (2007). Efectos bioquímicos postcosecha de la irradiación UV-C en frutas y hortalizas. Revista Fitotecnia Mexicana, 231-245.

[6] Ramos, Villarroel Millan, D., & Romero Gonzales, L. (2015). Luz ultravioleta: inactivación microbiana en frutas. Saber (online).

[7] Vega, L., & Fernández, O. (2001). Microorganismos antagonistas para el control. Avances en el Fomento de Productos Fitosanitarios No- Sintéticos, 3.