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Research article

In-Vitro Methicillin-Resistant Staphylococcus Aureus Photobiomodulation Eradication by Ultraviolet Light

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Abstract

Photobiomodulation eradication by Ultraviolet Light (UVL) 254 nm wavelengths exerts bactericidal effects, it was used in the disinfection. UVL showed anti Methicillin-resistant Staphylococcus aureus (MRSA) effects where using 280/300nm, with 4Dt value of 5 s observed in the bacterial suspension of 5 log CFU/mL as inactivation. UVL anti-bacterial spores cell wall, harm to DNA, RNA, and proteins by photo-hydration, photo-splitting, photo-crosslinking, and photo-dimerization. The aim was to use photobiomodulation eradication UVL methods for multi resistant MRSA that it had severe infection. So, it can help in disinfection and kill MRSA without chemical treatment. Preparation of MRSA strains, using "LED Apparatus"; the method was "Photobiomodulation Eradication by UVL". The results were presented the “Wavelengths (280+300) nm, were from (0-30 second)”. It was found from the result that the five MRSA strains gave a similar result, and the difference was noted that it was due to the characteristics of each MRSA strain alone and the resistance genes it contained. As for the result, it was very impressive to 30 minutes to completely eliminate all MRSA strains. It was concluded from the results that this photobiomodulation eradicated by UVL method was used to sterilize and eliminated MRSA strains that have drug multi resistance antibiotics within 30 seconds. It was recommended for using this photobiomodulation eradicated by UVL method to eliminate the multi resistance antibiotics strains that infect the skin. That could be through "Pharmacy Technology" to produce the dose that can be used for ski treatment without any harm to the patient.

Key Words: photobiomodulation; eradication; ultraviolet light; methicillin-resistant staphylococcus aureus; UVL; MRSA

Introduction

Photobiomodulation eradication by Ultraviolet Light (UVL) 254 nm wavelengths exerts bactericidal effects, it was used in the disinfection [1]. It had a rapid inactivation by UVC irradiation of bacterial, on droplet nuclei [2]. UVL showed anti Methicillin-resistant Staphylococcus aureus (MRSA) effects where using 280/300nm, with 4Dt value of 5 s observed in the bacterial suspension of 5 log CFU/mL as inactivation [3]. UVL revealed 4log action of pathogenic bacterial strains [4]. UVL TM, high-intensity flashing light (200–320nm) that done the bacteria and anti-bacterial spores cell wall, harm to DNA, RNA, and proteins by photo-hydration, photo-splitting, photo-crosslinking, and photo-dimerization [5]. UVL had action be upon quiescence of DNA reproduction on cells are in an inactive form, put off death by precaution their basal constituent, that straight treaty pathogenic bacterial DNA [4]. UVL had straight impacts DNA by the arrangement nitrogen bases, also mutations arising in different genes pertaining to DNA repair and replication [6]. UVL did Oxidation Processes sensual energy, control spoilage microorganisms used (220-280) nm, caused DNA physical change and suppress bacterial reproduction by arrangement of protein bases, artifact DNA reproduction, leading to cell death. The bactericidal acts mainly be on dose (J/m2) [7]. UVL had antibacterial capabilities, it was testing of the bactericidal potential of diffusing over a large area yielded killing results. It killing MRSA also examined using an in-vitro survival assay as disinfection [8]. The use of 222-nm UVL disinfection resulted in effective in-vitro reduction of MRSA and significantly reduced contamination [9]. Inhibition of Staph. aureus, from infected patients, after irradiation with LED; 300 µl of saline solution with bacterial suspension was irradiated. The comparison of the irradiated Staph. aureus 465 nm (40 J/cm2), ad with (30 and 50 J/cm2). MRSA strains were reduced into colony-forming units after LED irradiation [10]. The aim was to use photobiomodulation eradication UVL methods for multi resistant MRSA that it had severe infection. So, it can help in disinfection and kill MRSA without chemical treatment.

Materials and Methods

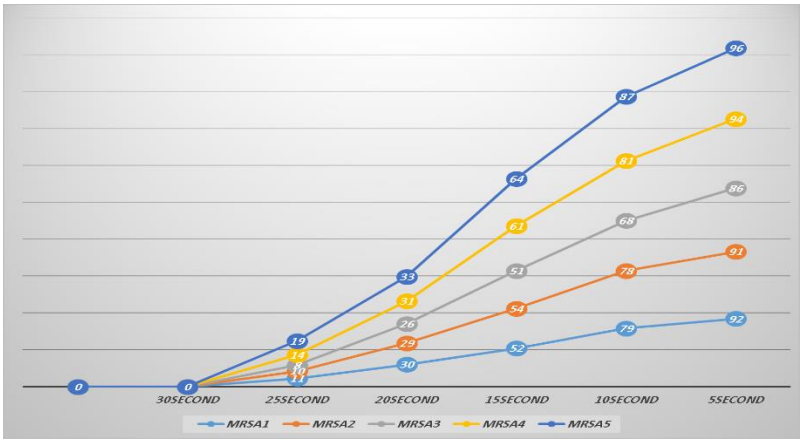
- **Preparation of MRSA strains:** The MRSA strains samples were collected from private hospital. They were inoculated into Tryptic Soy Broth (TSB) (Thermo Scientific, Pittsburgh, PA, USA) and grown overnight at 37˚ C. The cultures were resuspended in Fresh Broth (Thermo Scientific, Pittsburgh, PA, USA) for 2 hours. The strains were collected by centrifugation, washed, resuspended in Broth (Thermo Scientific, Pittsburgh, PA, USA). As well they were adjusted to 0.5 at 600 nm equal to 106 colony formation units (CFU) / mL of Hanks' balanced salt solution (HBSS) (Thermo Scientific, Pittsburgh, PA, USA) [11].
- **LED Apparatus:** It was (PearlLab Beam, Aquisense technologies, NC, USA), treated wavelengths (280+300) nm for (5, 10, 15, 20, 25, and 30 second), and Intensity/influence rate 0.112 W/cm^2 [3].
- **Photobiomodulation Eradication by Ultraviolet Light:** The MRSA strains suspensions 10 mL were expatriate in glassful Petri-dishes with ~6 mm and 24 cm^3. The Petri-dishes were centrally set in LED chamber spacing 5 cm [3].
- **MRSA Membrane Expedient:** The MRSA strains after photobiomodulation eradication by Ultraviolet Light were passed via bacterial membrane expedient. The filters were counted living cells / mL [12]
- **Statistical Study:** Entirely consequences were preserved by "IBM SPSS Statistics Software Form 21"; (IBM, Armonk, NY, United States) [13].

Results and Discussion

MRSA living cells / mL were photobiomodulation eradicated by UVL: the results were presented the "Wavelengths (280+300) nm, were from (0-30 second)". It was displayed the high significant MRSA living cells/ml were photobiomodulation eradicated by UVL (Table 1, and Graph 1). It was found from the result that the five MRSA strains gave a similar result, and the difference was noted that it was due to the characteristics of each MRSA strain alone and the resistance genes it contained. As for the result, it was very impressive to 30 minutes to completely eliminate all MRSA strains [1-4]. As for the strongest of them, the final eradication was MRSA5, as it remained for the time 25 seconds, and approximately one-fifth of the number of living cells was present. The fastest to eradicate it was MRSA3, were less than the tenth of living cells left. The average living cells/mL were by photobiomodulation eradicated by UVL elimination of live cells, it was proportional to the passage of time, so that the flow of time was consistent with the elimination of living cells [5-10]. It was found the arithmetic means to eliminate the isolates was in the first five seconds by eliminating tenth of living cells, then a quarter of the living cells were eliminated, then the elimination of half of the living cells, then two thirds of the quarters, and then more than four fifths of the living cells [1-4]. Evidence for the sequence in eliminating the isolates, as it took a longer time than the vegetative cells that did not have antibiotic resistance, but it was completely eradicated within 30 seconds. Since the effect was on the nuclear materials in cells and the ability to mutate or reproduce cells, and thus it was found that the method used was one of the radiological methods that eliminate bacteria resistant to antibiotics [1-4]. As it reduced the use of chemicals or chemical treatments, which affected the patient's body, and therefore this method could be used in the treatment of external injuries to the skin and the elimination of skin pathogens that caused by bacteria the characteristics of antibiotic resistance [5-10].

MRSA strains	**Wavelengths (280+300) nm**						
	0second	**5second**	**10second**	**15second**	**20second**	**25second**	**30second**
MRSA1	107/mL	92/mL	79/mL	52/mL	30/mL	11/mL	00/mL
MRSA2	105/mL	91/mL	78/mL	54/mL	29/mL	10/mL	00/mL
MRSA3	104/mL	86/mL	68/mL	51/mL	26/mL	8/mL	00/mL
MRSA4	106/mL	94/mL	81/mL	61/mL	31/mL	14/mL	00/mL
MRSA5	107/mL	96/mL	87/mL	64/mL	33/mL	19/mL	00/mL
Statistical analysis							
* $\tilde{x}$ **Mean**	**105.8**	**91.8**	**78.6**	**56.4**	**29.8**	**12.4**	**00**
*** P Probability value**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Table 1: MRSA living cells/mL were photobiomodulation eradicated by UVL



Graph 1: MRSA living cells/mL were photobiomodulation eradicated by UVL

Conclusion

It was concluded from the results that this photobiomodulation eradicated by UVL method was used to sterilize and eliminated MRSA strains that have drug multi resistance antibiotics within 30 seconds.

Recommendation

It was recommended for using this photobiomodulation eradicated by UVL method to eliminate the multi resistance antibiotics strains that infect the skin. That could be through "Pharmacy Technology" to produce the dose that can be used for ski treatment without any harm to the patient.

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