COMPARISION OF BACTERICIDAL ACTIVITY OF MICROWAVE, ULTRAVIOLET AND DISINFECTANT SOLUTIONS ON SOME BACTERIAL STRAINS

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ABSTRACT

In this study, bactericidal activity of microwave, ultraviolet (UV) and some of disinfectant solutions such as 1% Setridif and 2% Lysoformin and salina solution were investigated. Some bacterial strains such as Proteus vu1garis (6/10/225 RSKK), Bacillus cereus (RSKK 5127), Staphylococcus aureus (RSKK 395), Esc-herichia coli (MI. 205), Pseudomonas aeruginosa and Listeria monocytogenes were selected for this purpose. One minutes of microwave exposure was enough to destruct all the bacterial strains used in this study except B.cereus. We observed that 5 minutes of microwave exposure was not enough for destruction of B.cereus. However, any of B.cereus was not observed for 10 minutes of microwave exposure. On the other hand, three minutes of UV exposure was found enough for destruction of S. aerus and P. aeruginosa. 5 minutes of UV exposure was found necessary for destruction of P.vulgaris and L.monocytogenes. However, we observed that at least 10 minutes of UV exposure was necessary to destruct E.coli and B. cereus. 30, 45 and 60 minutes of salina treatment was not observed as destructive agent for bacterial strains under investigation. 30 minutes of setridif and lysoformin treatment was found enough for destruction of E. coli, S. aureus and L. monocytogenes. 30, 45 and 60 minutes of setridif treatment was not found enough for destruction of P.vulgaris and B.cereus while 30 minutes of lysoformin was found enough for bactericidal activity. 45 minutes of setridif was enough for destruction of P.aeruginosa while 30, 45 and 60 minutes of lysoformin was not enough for bactericidal activity of same bacteria.

In conclusion, these findings emphasize the need for caution in selecting an appropriate disinfectant or physical agents such as microwave and UV to use on contaminated surfaces.

Introduction

Nowadays, increasing prevalance of various infection diseases and their spread to population groups, in other words cross infection, has enhanced the importance of sterilization and disinfection in modern medical fields and particularly in dentistry.

The right way to prevent cross infecting and infection is to sterilize the tools (1). It has been reported that Streptococcus pyogenes, Neisse-ria gonnorhoea, Haemophilus spp, Streptococcus pneumoniae, Trepo-nema pallidum, Mycobacterium tuberculosis, Pseudomonas aerugino-sa, Rhinourus, viral hepatit virus are agents that can be transmitted by crossing infecting (2).

To prevent or decrease microbiologic crossing between dentists, technicians and pa-

tients, it is necessary to know which methods are to be applied for infection and sterilization (1).
In sterilization processes, dry hot air, autoclave, ethylene oxide gase, salt in higher temperature chemical sporoid solution, chemical steams, beat or meIted mine sterilization have been used as met-hods (1). Recently, several investigations have been carrried out as regards the use of ultraviolet and microwave energy as an alternative method to other sterilization methods (1).
Microwave has long been used for the sterilization or deconta-mination of different types of materials freeing them microorganisms (3). They have been used for reusable pharmaceutical glass vials, tis-sue culture plates, cultures media, contact lenses, dental instru-ments, babies bottles and decontamination of clinical specimens con-taining bacterial pathogens (1,3,4,5).
Electromagnetic energy in the microwave region (225 MHz to 100 GHz, typically 2450 MHz) is extensively studied as one of the alternative energy sources for sterilization. The efficiency of microwa-ve sterilization is essentially a function of both the electromagnetic field strength and the exposure time. The electromagnetic energy is expressed largely in two forms: 1 - The factors that depend on the dielectric properties of the dipole molecules of the irradiated materi-als in the form of heat (thermal effect) , and 2- the factors that do not depend on the dipole molecules in the form of a direct effect of the radiofrequency (nonthermal effect) (6).
UItraviolet radiation is that part of the electromagnetic spect-rum lying between the softest ionizing radiation on the one side and visible radiation on the other. For biological purposes, it is conveni-ent to regard the range of wavelengths from 100 to 380-400 nm as constituting UV.
Although UV radiation can arise from a large number of man-made sources, the sun is the main source, and both the general public and people working out of doors will be exposed to it. This naturel background must be taken into account, when exposures li-mits are discussed (7).
UV lights can kill microorganisms, or inactive them by dama-ging their DNA (8). Also, UV lights cause to mutations. For disinfec-tion of springs of water, laboratory, instruments, rooms UV light is used due to its known effects (2).
The present study was aimed to determine bactericidal activity of microwave, ultraviolet, and disinfectant solutions on various bacterial strains.

Materials and Methods

In this study, UV source (Steristom 2537 A^0) and Microwave oven (550 Watt, 2450 MHz, Imperial V-8505 T Model) were used to investigate bactericidal activity of electromagnetic radiation on some bacterial strains such as Proteus vu1garis (6/10/225 RSKK), Bacillus cereus (RSKK 5127), Staphylococcus aureus (RSKK 395), Esc-herichia coli (MI. 205), Pseudomonas aeruginosa and Listeria monocytogenes.

Microbiological process

Bacterial strains was carried out in saline suspension and adjusted according to 0.5 Mc Farland turbidity. Prepared suspension contained 10^8 bacteria/ml..

Microwave exposure

In this step of the study, each of petri dishes containing bacterial strains, which is prepared according to microbiological procedure were placed to central of microwave oven. Each group of bacterial strains in microwave exposure group was divided 6 experimental group (n: 10 petri dishes) and exposed to microwave at full power for different exposure time such as 0.5, 1,2, 5, 10, 15 minutes.

Ultraviolet exposure

In this experimental group, half of each petri dishes (by covering black cartoon) in each of bacteria group, which is prepared according to microbiological process was exposed to UV radiation. Each group of bacterial strains in UV exposure group was divided 4 experimental group (n: 10 petri dishes) and exposed to UV radiation for different exposure time such as 3, 5, 10 and 20 minutes.

Treatment of disinfectant solutions

Three disinfectant solution such as setridif, lysoformin and salina were used to investigate bactericidal activity. Petri dishes of each bacterial strains under investigation were divided to three experimental groups according to treatment time, which are 30, 45 and 60 minutes respectively. Features of disinfectant solution are given follow:

1 % Setridif solution: 1ml of setridif completed to 100 ml of distilled water.

2 % Lysoformin: 2 ml of lysoformin completed to 100 ml of distilled water.

Salina: Edetate Disodium 0.0259, Sorbic acid 0.1 mg, isotonic and buffered solution g.s to 100 ml contains no thimerosal.

Results and Discussion

The results of this study showed that one minutes of microwave exposure was enough to destruct all the bacterial strains used in this study except B.cereus. We observed that 5 minutes of microwave exposure was not enough for destruction of B.cereus. However, any of B.cereus was not observed for 10 minutes of microwave exposure (**Table 1**). On the other hand, three minutes of UV exposure was found enough for destruction of S. aerus and P. aeruginosa. 5 minutes of UV exposure was found necessary for destruction of P.vulgaris and L.monocytogenes. However, we observed that at least 10 minutes of UV exposure was necessary to destruct E.coli and B. cereus (**Table 2**).

TABLE 1

Results of the study related to bactericidal activity of microwave radiation

Organisms	Bacteria/ml	Microwave exposure (minute)					
		0.5	1	2	5	10	15
E. coli	10^8	+	-	-	-	-	-
S. aureus	10^8	+	-	-	-	-	-
P.vulgaris	10^8	+	-	-	-	-	-
P.aeruginosa	10^8	+	-	-	-	-	-
B.cereus	10^8	+	+	+	+	-	-
L.monocytogenes	10^8	+	-	-	-	-	-

+: Growing -: No growing ±: Decrease in growing

30, 45 and 60 minutes of salina treatment was not observed as destructive agent for bacterial strains under investigation. 30 minutes of setridif and lysoformin treatment was found enough for destruction of E. coli, S.

TABLE 2

Results of the study related to bactericidal activity of ultraviolet

Organisms	Bacteria/ml	Ultraviolet exposure (minute)			
		3	5	10	20
E. coli	10^8	+	±	-	-
S. aureus	10^8	-	-	-	-
P.vulgaris	10^8	+	-	-	-
P.aeruginosa	10^8	-	-	-	-
B.cereus	10^8	+	±	-	-
L.monocytogenes	10^8	±	-	-	-

+: Growing -: No growing ±: Decrease in growing

TABLE 3

Results of the study related to bactericidal activity of disinfection solution

Bacterial Strains	30 min of treatment			45 min of treatment			60 min of treatment		
	Setridif	Lysoformin	Salina	Setridif	Lysoformin	Salina	Setridif	Lysoformin	Salina
E.coli	-	-	+	-	-	+	-	-	+
S.Aerus	-	-	+	-	-	+	-	-	+
P.vulgaris	±	-	+	±	-	+	±	-	+
P.aeruginosa	±	+	+	-	±	+	-	±	+
B.cereus	±	-	+	±	-	+	±	-	+
L.monocytogenes	-	-	+	-	-	+	-	-	+

+: Growing -: No growing ±: Decrease in growing

aureus and L. monocytogenes. 30, 45 and 60 minutes of setridif treatment was not found enough for destruction of P.vulgaris and B.cereus while 30 minutes of lysoformin was found enough for bactericidal activity. 45 minutes of setridif was enough for destruction of P.aeruginosa while 30, 45 and 60 minutes of lysoformin was not enough for bactericidal activity of same bacteria (**Table 3**). All the results of this study are shown tables given follow:

Widespread of infection diseases makes sterilization primer factor in medical and dentistry area. Recently, sterilization met-hods with microwave energy and ultraviolet lights have increased considerably. It is known that other sterilization methods such as autoclave, pasteur oven require both longer time and much more ex-penditure.

It has been reported that micro-wave and UV sterilisation is achieved in shorter time. For instance, Rohrer et al showed that 8 min-

utes of 2450 MHz microwave exposure is enough for bacterial sterilization and 4 minutes of microwave is enough for viral sterilization in microwave oven (4).

Microwave sterilization or disinfection may provide a useful alternative to the currently available system. On the other hand, lethal effects of microwave exposure on microorganism have been known for over 30 years. However, scientist focused on food disinfection/sterilization. Dasdag et al reported that microwave is more effective agent than conventional heating in term of sterilization of L.monocytogenes from meat (9). Same authors also showed that microwave and shortwave can alter the antimicrobial activity (10). Atmaca et al. also indicated effects of microwave on survival of some bacterial strains (11). Similarly, Akdag et al. reported that microwave sterilise dispossible micropipet tips and microwave can be used in disinfection of E.coli K12 and valine (12,13). Aksen et al also indicated role of microwave in terms of disinfection of L. monocytogenes from food (14). By the way, the author of this article also compared sterilization/disinfection capacity of 2450 MHz microwave and conventional heating in terms of sterilization of L. monocytogenes from milk and Kaya et al. emphasize that microwave has interestingly an advantage related to boiling and cooling speed of milk (15).

The result of this study related to microwave sterilization indicated that 1 minutes of 2450 MHz microwave at full power destruct 5 of bacterial strains, which are Proteus vu1garis (6/10/225 RSKK), Staphylococcus aureus (RSKK 395), Esc-herichia coli (MI. 205), Pseudomonas aeruginosa and Listeria monocytogenes. However, 10 minutes of microwave exposure is enough to destruct Bacillus cereus (RSKK 5127). Consequently, our results related to microwave disinfection are in an agreement with results of the studies mentioned above. We also state that microwave can't destruct all the bacterial strains at the same exposure time. However, microwave can disinfect all the bacteries in a shorter but different time.

The results of this study related to UV disinfection is also is in an agreement with the results of UV studies mentioned in introduction (2,8).

Van de Weyer et alindicated that Listeria are not particularly resistant to disinfectants but efficacy of some age is affected by organic matter (16). Vizcaino-Alcaide et al. Reported that Perasafe is a good substitute for 2 % glutaraldehyde for high-level disinfection(17). Best et al. Emphasize the need for caution in selecting an appropriate disinfectant to use on contaminated surfaces, particularly in the presence of organic materials (18). The results of our studies related to disinfectant solutions also showed similar results. According to the results of present study we can say that microwave sterilization is more effective and shorter than UV sterilization or disinfectant solutions. Because, 1 minutes of microwave exposure was found enough to destroy bacteries used in thiº study except B. cereus. However 10 minutes of exposure is also enough for it.

Finally, each physical or chemical disinfectant agent can't show same performance in terms of sterilization. Thus, selection of appropriate agent is very important parameter in sterilization studies.

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