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"From the sun to the earth" – Use of solar energy for infectious biomedical waste management.

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Abstract

Background: Despite the advances in biomedical waste management, quest for cost- effective and eco-friendly solutions is still on. The present study was conducted to check the efficacy of solar cooker in the management of infectious biomedical waste. Material and Method: The study was conducted using a box type solar cooker to check the difference in the colony count of the microbial colony before and after using the solar cooker. Result: It showed a significant reduction in the colony forming units after using the solar cooker for 3 days only. Conclusion: It proved that solar energy can be used for infectious biomedical waste management thus giving us an eco friendly, cost effective and a user friendly technique for the treatment of such wastes.

Introduction

With an increasing population, biomedical waste load is also increasing in our country. The management as well as the associated environmental and health risks of biomedical waste is of global concern. Biomedical waste may be disposed using different methods which many countries have adopted. However, the disposal of biomedical waste needs to be carried out in a way that neither the environment nor the health conditions of people are put at risk as they are perilous. Poor developing countries that have small health budgets cannot afford expensive technologies such as incineration, microwave, and hydroclave.[1] Thus, such countries need low cost biomedical waste management alternatives such as bioremediation, vermicomposting and solar cooker. One of the promising avenues involves the use of solar power. Solar energy is freely available and could be used for treatment of infectious contaminated waste. The solar heating systems should provide a cheap disinfection option to treat infectious waste in countries that are less economically developed. [1]

Aims and Objectives

To check the efficacy of solar cooker/ solar energy for infectious biomedical waste management.

Materials & Methods

A total of 30 pre-treatment and 30 post-treatment samples were taken in this study. They were divided into categories which included LA bottle, Gloves, Vacutainer, Anatomical waste, Soiled cotton and syringe. [Fig. 1] Five samples from each of these categories were randomly selected for the study.

Pre-treatment: A sterile cotton swab dipped in sterile normal saline was rolled over the surface of the infectious biomedical waste. [Fig 2] The sterile cotton swabs were dropped into Brain Heart Infusion broth and incubated for 2 hours. [Fig 3] 100 microlitres of this broth were utilized to grow the species on Blood Agar. [Fig 4] This was incubated aerobically at 37°C for 2 days.

Post-treatment: All the samples were kept in a box type solar cooker for 3 consecutive days and the culture was done using the same above mentioned technique.

All the white colored colonies were counted using direct plate counting. [Fig. 5, 6]

Results

Comparison of six groups with pre- and post-treatment log Colony forming units by Kruskal Wallis test and Wilcoxon matched pair test. The result was found to be statistically significant. ($p < 0.05$) [Table 1, Graph 1]

Discussion

Poor developing countries cannot afford expensive technologies such as incineration for management of infectious biomedical waste. The solar heating system provides a cheap disinfection option to treat infectious biomedical waste in countries that are less economically developed. ***Chitnis et al*** reported a 7 log reduction in the amount of viable bacteria and concluded solar heating as an alternative technology for biomedical waste management. [1] ***Nathavitharana et al*** effectively studied sterilization of Mycobacterial bacterial cultures using solar cooker. They stated simulated culture plates at concentrations from 10^3 colony-forming-units (CFU)/ml to 10^7 CFU/ml were completely sterilized after only one hour of cooker exposure, at temperatures between 50–102°C. By 30 minutes all plates were effectively sterilized. [2] ***Sarojini E et al*** studied the effect of solar treatment for disinfection of biomedical wastes with and without lime stabilization process. They reported the reduction percentages of COD and alkalinity were 77% and 76% respectively for solitary solar disinfection, whereas for solar disinfection with lime stabilization COD and alkalinity were reduced to 65.79% and 70.87% respectively and suggested that pathogens of biomedical waste can be effectively destroyed using solar disinfection with lime stabilization process.[3] The change in mean from pre-treatment to post-treatment came out to be 0.29, 2.60, 0.23, 0.00, 2.24 and 1.74 for LA bottle, gloves, vacutainer, anatomical waste, soiled cotton and syringe respectively in our study. The p value came out to be 0.0001, 0.0010 and 0.0030 for pre-treatment, post-treatment and the difference between pre-treatment and post- treatment value respectively ($p < 0.05$). We have demonstrated that solar disinfection provides a very effective and low-cost alternative to conventional equipments used for BMW management.

Conclusion

Since this study has proved that solar energy can be used to disinfect BMW efficiently, further cross-sectional studies with larger samples may be required to establish the same.

References

1. Chitnis et al. Solar disinfection of infectious biomedical waste: a new approach for developing countries. THE LANCET • Vol 362 • October 18, 2003.
2. Nathavitharana et al. Solar Disinfection of MODS Mycobacterial Cultures in Resource-Poor Settings.

3. Sarojini E et al. Effect of solar radiation on disinfection of infectious biomedical wastes. J Environ Sci Eng. 2010 Apr; 52(2):93-6.

Figures and Legends

Fig. 1 showing the Armamentarium used in the study. a) Box type solar cooker, b) Samples in zip pouch, c) instruments required for the study and BHI broth, d) Blood agar plates.

Fig. 2 shows taking a swab from the soiled cotton sample.

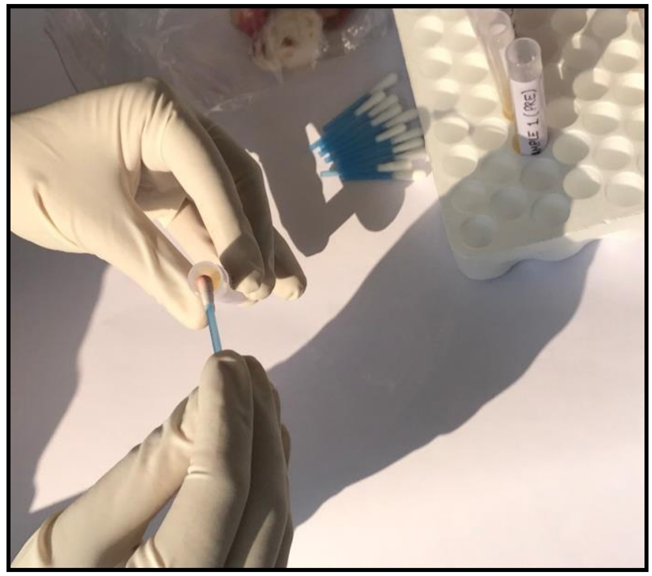

Fig. 3 shows dropping the swab into BHI broth.

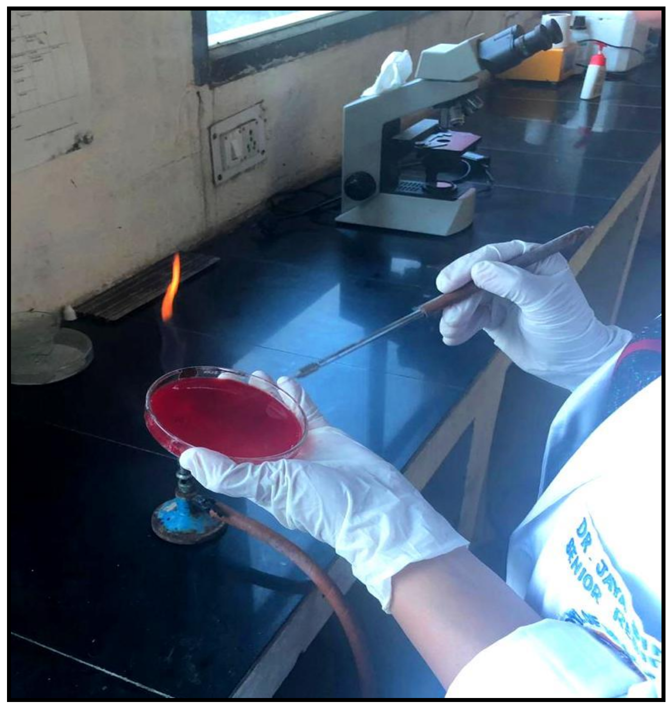

Fig. 4 shows streaking the blood agar plate.

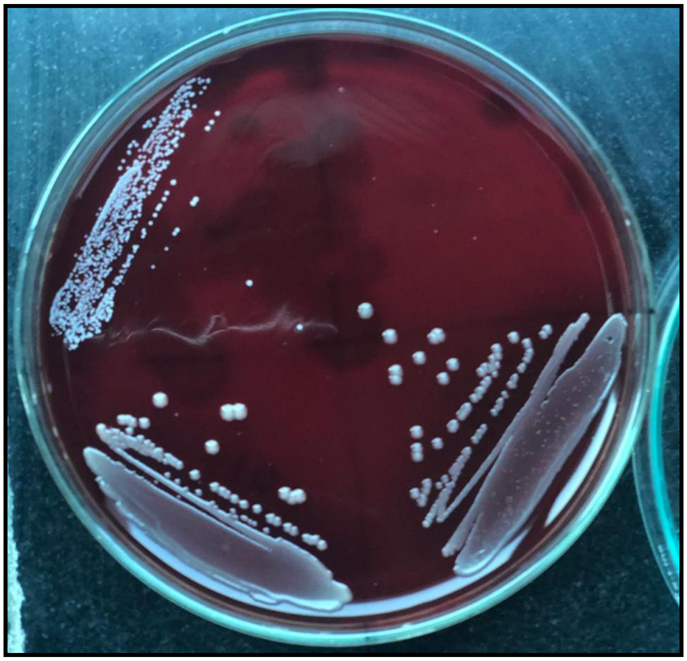

Fig. 5 shows bacterial colony of the pre-treated sample.

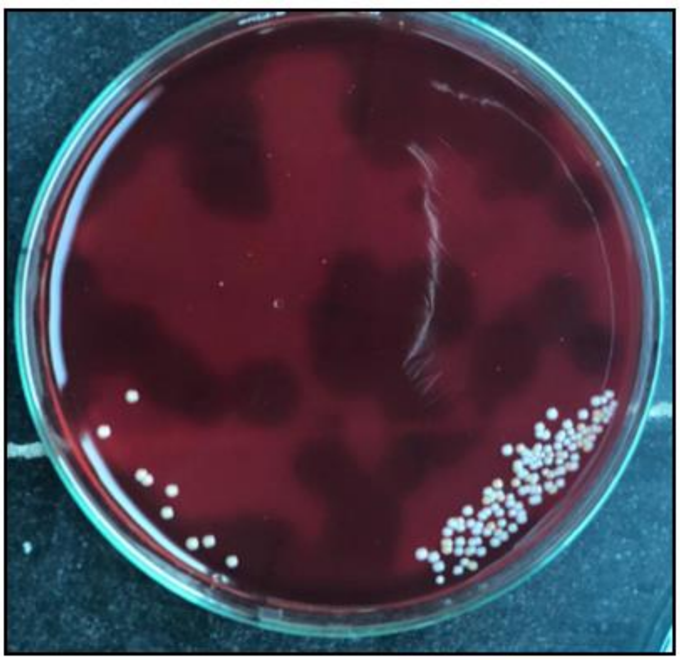

Fig. 6 shows the reduced bacterial colony of the post-treated sample.

Tables and Graphs

Table 1: Comparison Of Six Groups With Pre Treatment And Post Treatment Log CFU Counts By Kruskal Wallis ANOVA

Groups	Pre treatment			Post treatment			Changes		
	Mean	SD	Mean rank	Mean	SD	Mean rank	Mean	SD	Mean rank
LA Bottle	0.92	0.06	8.20	0.64	0.10	8.00	0.29	0.06	13.60
Gloves	4.60	1.14	24.90	2.00	1.00	22.50	2.60	1.52	23.70
Vacutainer	1.54	0.32	13.80	1.30	0.32	17.10	0.23	0.04	10.80
Anatomical waste	0.00	0.00	3.00	0.00	0.00	3.00	0.00	0.00	4.00
Soiled cotton	3.80	1.30	22.40	1.56	0.52	20.90	2.24	1.58	21.80
Syringe	3.40	1.82	20.70	1.66	0.41	21.50	1.74	1.77	19.10
H-value	24.5830			21.5080			18.1720		
p-value	0.0001*			0.0010*			0.0030*