



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.
Thesis Title:
Design and Development of a Sterilization Box and its Variants with Different Functionalities
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Thesis Submitted to the Department/ Center : Mechanical Engineering
Date of completion of Thesis Viva-Voce Exam : 22/8/2024
Key words for description of Thesis Work : Product design, COVID-19, Sterilization, Antibacterial activity, Pedagogy, Artificial ageing

SHORT ABSTRACT

The purpose of design and development of a new product is to transform ideas into tangible products. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) prompted the researchers to design and develop a sterilization box for the prevention of coronavirus disease 2019 (COVID-19). In this work, first a sterilization box was designed with combined Ultraviolet-C (UV-C) radiation and incandescent bulb heating facilities. For performance assessment, initially unfolding of Immunoglobulin G (IgG) and antibacterial efficacy for the clinically relevant *E. coli* bacteria as well as for bacteria collected from daily use items were assessed. UV-C exposure 70 °C for 15 min unfolded the protein and killed all the bacteria. As a product diversification strategy, another sterilization box with Infrared (IR) and UV-C facilities was designed; its disinfection ability was tested against *S. aureus* and *S. typhi* bacteria and SARS-CoV-2 spike and RNase A proteins. For the broad-spectrum antibacterial activity, the optimum condition was UV-C exposure at 65.61 °C for 13.54 min. For understanding the effect on N95 masks, five disinfection methods, viz., incandescent bulb heating, UV-C irradiation, air drying after alcohol immersion, exposing to steam, and incandescent bulb heating combined with UV-C irradiation were studied. Alcohol treated and UV-C treated fibers became wider and rougher than the untreated fibers. Incandescent bulb heating combined with UV-C irradiation caused the least reduction in ultimate tensile strength (UTS) and scratch resistance. Further, sterilization box was transformed into a pedagogical gadget for product diversification. Five pedagogical heat transfer experiments with the help of developed gadget were described. Survey and educational assessment were carried out to check the pedagogical effectiveness of the

gadget. Feedback from the participants provided important information related to the gadget. In general, the potential users found the developed gadget very useful for improving teaching-learning activity. Furthermore, sterilization box was used for artificial ageing of rice, showing its another functionality. Artificial ageing positively impacts the cooking and eating qualities of rice, but natural ageing takes years. The optimized condition of artificial ageing for Ranjit rice using IR and UV-C was found to be heating at 70 °C for 5 h. No significant changes in nutritional values viz., starch, protein, and fat were observed in artificially aged rice in comparison to one-year-old naturally aged rice. Electron microscopy analysis showed no changes in the structure of starch granules, which further revealed no adverse effect of IR radiation heating on the microstructure of rice. Results from the spread plate assay showed no growth of bacterial colony indicating the antibacterial effectiveness of artificial ageing. Thus, artificial ageing of rice can be successfully carried out using combined IR heating and UV-C radiation without compromising the nutritional values. Overall, this comprehensive study contributes to the product design with different functionalities.