Infrared Surface Decontamination of Whole Shell Eggs - Mathematical Modeling for Process and System Design

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Microbial contamination of daily products especially fresh whole shell eggs has been a common food safety problem. While the interior of the egg is assumed to be safe as long as they are obtained from healthy poultry, eggs can easily be subject to microbial contamination. This surface contamination might then penetrate through the shell and cause deterioration during the storage. Hot water pasteurization is currently applied in industry for surface contamination, but this cases a significant wastewater and possible cross-contamination problems. Far - Infrared radiation technology is a novel method which is commonly preferred with its low penetration ability and suitability for the surface decontamination process while it also offers a high energy efficiency.
In this study, a mathematical model to determine the surface temperature of whole shell eggs was developed using COMSOL Multiphysics v6.0 (Comsol AB, Stockholm, Sweden) and experimentally validated. The experimental studies were carried out in an 18-seramic far infrared source batch and 4-source continuous pilot-scale system. A black aluminum object (with the emissivity value of ?1) was first used to determine the system surface parameters, and then the egg surface temperatures were determined using type-K 36 gauge thermocouples. An infrared camera was also used to determine the surface temperature distribution. Following the model validation studies, various processing possibilities were explored for industrial scale systems in tunnel designs.
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