



DENSOVO : A Chicken Egg Spoilage Detection Device Based on Volume and Density Calculation Using Mathematical Modeling

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Abstract

Food products generally undergo spoilage over time, which affects their quality and safety for consumption. One of the most widely consumed foods worldwide is the chicken egg, due to its high nutritional value and importance as a protein source. However, when eggs are stored for extended periods, spoilage occurs, and such deterioration cannot be clearly identified by visual inspection. Consumption of spoiled eggs may pose health risks. Therefore, this study investigated the physical changes of chicken eggs over a period of 12 days. The results showed that both mass and density decreased continuously over time, while the volume remained relatively constant, based on this relationship, a linear equation was established between density and time, and further developed into an innovation capable of sorting and assessing egg freshness, as well as predicting spoilage in a non-destructive manner. The system utilizes a mathematical model developed by the authors to estimate egg volume $V = \frac{20\pi ab^2 + (4\pi a^3)(\tan(\theta))^2}{15}$ where a represents the half-longitudinal length of the chicken egg in centimeters, b represents the half-transverse length of the chicken egg in centimeters, which is then used to calculate density. In addition, the linear model is applied to estimate the remaining time before spoilage. The volume estimation model of the device exhibited a low average error of only 2.93%, indicating acceptable accuracy for practical applications.

Keywords: Egg freshness assessment, Egg spoilage prediction, Density analysis, Mathematical modeling, Non-destructive testing, Volume estimation