Finding Perfect Watermelons: Non-Destructive Ripeness Detection via Photoacoustics - A Pilot Study

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The quality and taste of a watermelon mainly depend on its ripeness degree. As the watermelon ripens, the redness of its inner flesh increases, while the thickness of the outer rind shrinks. However, the current non-destructive testing methods, based on sound or light reflection / transmission, cannot measure these two hallmarks with adequate robustness and accuracy, which is mainly due to the requirement of complex modeling and classification. To address this issue, the project is to explore a new hybrid approach, photoacoustics (PA), to detect the watermelon ripeness. Specifically, PA shockwaves are excited in the watermelon by short laser pulses, and then detected by an ultrasound transducer. The strength and travel time of PA signals are closely linked to the flesh redness and the rind thickness, respectively. Therefore, the PA signals can be directly used to detect these two hallmarks without complex modeling and classification. To explore its feasibility, several experiments were designed and conducted to investigate the optical and acoustic (absorption and transmission) properties of watermelon samples for optimizing the PA excitation and transmission conditions. Through these experiments, the optical and acoustic transmission windows through the rind were identified, the acoustic velocity was characterized, and the PA excitation and transmission were demonstrated. The preliminary experimental results show that photoacoustics is promising to serve as a new, direct, and accurate approach for watermelon ripeness detection.

Awards Won:
Third Award of $1,000