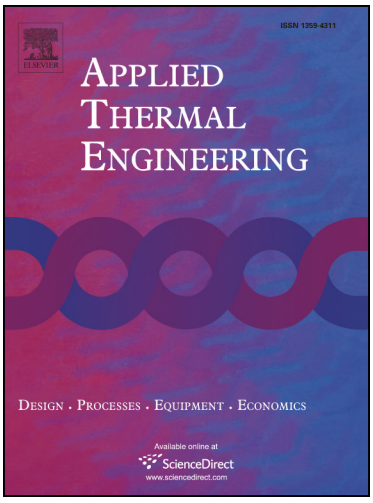

Research Paper

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Identifying heterogeneities in cooling and quality evolution for a pallet of packed fresh fruit by using virtual cold chains

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Abstract

Temperature control of fresh produce by forced convective cooling through ventilated packaging is essential to preserve quality in postharvest supply chains. The challenge is to achieve uniform cooling of fruit in the entire cargo. Most numerical research using computational fluid dynamics (CFD) focused on ventilated packaging with relatively small ensembles of fruit. This study aims to gain more insight into the thermal heterogeneity and the associated differences in quality evolution for large ensembles of packed fruit, by investigating the thermal behavior of an entire pallet of fruit throughout the entire cold chain. To this end, the virtual cold chain method is applied, which virtually tracks the temperature-time history of individual fruit using CFD and accordingly predicts fruit quality evolution using kinetic rate law models. The pallet includes 80 cartons, in which 5120 fruit are explicitly modelled as discrete spheres. Three cold chain scenarios are evaluated. For all the three unit operations in a cold chain (precooling, transport and

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