

Virtual Prototyping of Ventilated Corrugated Fibreboard Carton of Fresh Fruit for Improved Containerized Transportation

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Abstract : This study introduces a comprehensive method for designing ventilated corrugated fiberboard carton for fresh fruit packaging utilising virtual prototyping. The technique efficiently assesses and analyses the mechanical and thermal capabilities of fresh fruit packing boxes prior to making production investments. Comprehensive structural, aerodynamic, and thermodynamic data from designs were collected and evaluated in comparison to real-world packaging needs. Physical prototypes of potential designs were created and evaluated afterward. The virtual prototype is created with computer-aided graphics, computational structural dynamics, and computational fluid dynamics technologies. The virtual prototyping quickly generated data on carton compression strength, airflow resistance, produce cooling rate, spatiotemporal temperature, and product quality map in the cold chain within a few hours. Six distinct designs were analysed. All the various carton designs showed similar effectiveness in preserving the quality of the goods. The innovative packaging box design is more compact, resulting in a higher freight density of 1720 kg more fruit per reefer compared to the commercial counterpart. The precooling process was improved, resulting in a 17% increase in throughput and a 30% reduction in power usage.

Keywords : postharvest, container logistics, space/volume usage, computational method, packaging technology

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