

Determination of Mechanical Properties of Tomato Fruits: Experimental and Finite Element Analysis

Authors : Mallikarjunachari G., Venkata Ravi M.

Abstract : The objective of this research work is to evaluate the mechanical properties such as elastic modulus and critical rupture load of tomato fruits. Determination of mechanical properties of tomato fruits is essential in various material handling applications, especially as related to robot harvesting, packaging, and transportation. However, extracting meaningful mechanical properties of tomato fruits are extremely challenging due to its layered structure, i.e., the combination of exocarp, mesocarp, and locular gel tissues. Apart from this layered structure, other physical parameters such as diameter, sphericity, locule number, and, the surface to volume ratio also influence the mechanical properties. In this research work, tomato fruits are cultivated in two different ways, namely organic and inorganic farming. Static compression tests are performed to extract the mechanical properties of tomato fruits. Finite element simulations are done to complement the experimental results. It is observed that the effective modulus decreases as the compression depth increase from 0.5 mm to 10 mm and also a critical load of fracture decreases as the locule number increases from 3 to 5. Significant differences in mechanical properties are observed between organically and inorganically cultivated tomato fruits. The current study significantly helps in the design of material handling systems to avoid damage of tomato fruits.

Keywords : elastic modulus, critical load of fracture, locule number, finite element analysis

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