

Analysis of Compressive and Tensile Response of Pumpkin Flesh, Peel and Unpeeled Tissues Using Experimental and FEA

Authors : Maryam Shirmohammadi, Prasad K. D. V. Yarlagadda, YuanTong Gu

Abstract : The mechanical damage on the agricultural crop during and after harvesting can create high volume of damage on tissue. Uniaxial compression and tensile loading were performed on flesh and peel samples of pumpkin. To investigate the structural changes on the tissue, Scanning Electron Microscopy (SEM) was used to capture the cellular structure change before and after loading on tissue for tensile, compression and indentation tests. To obtain required mechanical properties of tissue for the finite element analysis (FEA) model, laser measurement sensors were used to record the lateral displacement of tissue under the compression loading. Uniaxial force versus deformation data were recorded using Universal Testing Machine for both tensile and compression tests. The experimental Results were employed to develop a material model with failure criteria. The results obtained by the simulation were compared with those obtained by experiments. Note that although modelling food materials' behaviour is not a new concept however, majority of previous studies focused on elastic behaviour and damages under linear limit, this study, however, has developed FEA models for tensile and compressive loading of pumpkin flesh and peel samples using, as the first study, both elastic and elasto-plastic material types. In addition, pumpkin peel and flesh tissues were considered as two different materials with different properties under mechanical loadings. The tensile and compression loadings were used to develop the material model for a composite structure for FEA model of mechanical peeling of pumpkin as a tough skinned vegetable.

Keywords : compressive and tensile response, finite element analysis, poisson's ratio, elastic modulus, elastic and plastic response, rupture and bio-yielding

Conference Title : ICASFE 2016 : International Conference on Agricultural Science and Food Engineering

Conference Location : London, United Kingdom

Conference Dates : May 23-24, 2016