

Title Three-point bending: An alternative method to measure tensile properties in fruit and vegetables

Author Marvin J. Pitts, Denny C. Davis and Ralph P. Cavalieri

Citation Postharvest Biology and Technology, Volume 48, Issue 1, April 2008, Pages 63-69

Keywords Fruit; Tissue; Tensile; Material properties; Elastic modulus

Abstract

Tensile mechanical properties of fruit and vegetable tissue are likely to have a significant effect on fruit and vegetable quality evaluations. Very few studies have been made of tensile material properties because sample preparation for uniaxial tensile testing of fruit and vegetable tissue is difficult. Three-point bending is an alternative experimental method to measure tensile elastic modulus. In this study a derivation of bending theory was developed and used in conjunction with a three-point bending procedure using digital image-based analysis to locate the neutral axis of the material. Mechanics of materials theory and concepts were used to determine a relationship between the location of the neutral axis and the ratio of compressive elastic modulus to tensile elastic modulus. The procedure to locate the neutral axis and the derivation to determine the tensile elastic modulus were verified using a homogeneous cork-based material which exhibited distinctly different compressive and tensile properties. Tensile elastic modulus measured using the bending apparatus agreed closely (within 1%) to tensile elastic modulus measured using a uniaxial tension apparatus. This experimental method is well suited to measure tensile properties in many fruit and vegetables.