Mechanical characterization of edible films by nanoindentation technique

I. Arzate Vázquez¹, A. Martínez Rivas², J.G. Cabañas Moreno², J. J. Chanona Pérez¹,
¹Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Plan de Ayala y Carpio s/n, 11340, D.F. México.
²Centro de Nanociencias y Micro y Nanotecnologías (CNMN), Instituto Politécnico Nacional, Luis enrique Erro s/n, Unidad Profesional Adolfo López Mateos, Zacatenco, 07738, D.F. México.

The nanoindentation technique is a mechanical test to determine properties such as hardness or Young's modulus, among others which can be obtained from the load-displacement curves [1, 2]. Otherwise, research works relating to nanoindentation tests on edible films are not enough found in literature, hence the aim of this study is to perform nanoindentation tests on alginate and chitosan films, with the objective of: 1) determining mechanical properties such as hardness and Young's modulus and 2) studying the effects of operating variables (maximum load, pause and loading and unloading rate) on the mechanical properties. Alginate and chitosan edible films (with a thickness of 60 µm) were prepared by casting method and dried at 60 °C. The films were stored at a relative humidity of 57%. The films were placed onto a bulk fused silica to carry out nanoindentation tests. All nanoindentation tests were performed under the same conditions and found that hardness and Young's moduli values for alginate films were 12.65 ± 0.39 MPa and 330.00 ± 43.00 MPa respectively, which are higher than those obtained for chitosan films (7.96 ± 0.10 MPa and 148 ± 2.00 MPa). Moreover, it was found that the operating variables directly influence the mechanical properties measurements and both films exhibit a creep behavior. Nanoindentation technique can provide relevant information about the properties and mechanical behavior of edible films, which can be supplemented and correlated with mechanical tests traditionally performed on such biomaterials.

Keywords: Nanoindentation tests, alginate and chitosan edible films, mechanical properties.

Work supported by projects: SIP-IPN 20100771, 20101130 and CONACYT 59730.


Emails for correspondence: alexfe26@yahoo.com.mx; jchanona@ipn.mx