Development of Antimicrobial Film Based on Pectin-ZnO Bio-nanocomposites

国連大学生研究成果

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Nugraha Edhi Suyatma

UNU-Kirin Fellow from Indonesia
Food Packaging Laboratory
National Food Research Institute, NARO

In recent years, antimicrobial packaging has attracted much attention from the food industries thanks to the increase in consumer demand for preservative-free products. Moreover, there has been a growing interest in developing biodegradable packaging materials to replace petroleum based polymers. As a by-product of fruit processing industries, biopolymer pectin is both inexpensive and abundantly available, which is thus an excellent candidate for applying to eco-friendly biodegradable packaging. Unfortunately, films prepared with pure pectin did not provide satisfactory functionality due to lack of mechanical properties and water resistance. The main goal of this study is to enhance functional packaging properties of pectin film prepared by blending pectin with zinc oxide nanoparticles (ZnO-NPs). Pectin/ZnO bio-nanocomposite films were fabricated at 4 levels of ZnO-NPs, i.e., 0.5, 1.0, 2.0 and 5.0% (w/w) with the addition of glycerol (10%, w/w) as plasticizer. The effects of ZnO-NPs incorporation on improving the mechanical properties and water resistance of the films were investigated.

Zinc oxide (ZnO) nanoparticles were successfully incorporated into pectin films by preparing pectin-ZnO-NPs solution and casting method. The presence of ZnO-NPs inside pectin films was observed clearly by using SEM and confirmed with FTIR spectra analysis. The improvement in tensile strength could be achieved with ZnO-NPs incorporation without obvious loss in elasticity. Thus, the addition of glycerol as plasticizer was not an important or necessary factor for preparing pectin-ZnO nanocomposite films. Water absorption of pectin-ZnO nanocomposite films was lower than that of pure pectin film, indicating that the improvement in water resistance had been achieved. Converse effect was observed by using glycerol as plasticizer which increased water absorption of the films. Antimicrobial activity of pectin-ZnO nanocomposite films was proved in the absence of mold after exposing them at 97% RH and room temperature for 14 days, whereas the growth of mold had been observed in pectin films after 5 days of exposure. The application of pectin-ZnO nanocomposite as edible coating of strawberry could inhibit the mold decay until two weeks with the storage at 5℃, a week longer than that of control. In terms of color analysis, the significant change in film opacity was only found in the film formed by using 5% of ZnO. Results suggested that it would be favorable to prepare antimicrobial film by using ZnO-NPs at the amount of 2% (w/w) without plasticizer in the future work.