

# **Optimization of Biocomposite Film Based on Whey Protein Isolate and Nanocrystalline Cellulose from Pineapple Crown Leaf Using Response Surface Methodology**

## **ABSTRACT**

This study employed response surface methodology to optimize the preparation of biocomposites based on whey protein isolate, glycerol, and nanocrystalline cellulose from pineapple crown leaf. The effects of different concentrations of nanocrystalline cellulose as a filler and glycerol as a plasticizer on the thickness, the tensile strength, and the elongation at break on the resulting biocomposite films were investigated. The central composite design was used to determine the optimum preparation conditions for biocomposite films with optimum properties. The regression of a second-order polynomial model resulted in an optimum composition consisting of 4% glycerol and 3.5% nanocrystalline cellulose concentrations, which showed a desirability of 92.7%. The prediction of the regression model was validated by characterizing the biocomposite film prepared based on the optimum composition, at which the thickness, tensile strength, and elongation at break of the biocomposite film were 0.13 mm, 7.16 MPa, and 39.10%, respectively. This optimum composition can be obtained in range concentrations of glycerol (4–8%) and nanocrystalline cellulose (3–7%). Scanning electron microscope images showed that nanocrystalline cellulose dispersed well in the pure whey protein isolate, and the films had a relatively smooth surface. In comparison, a rough and uneven surface results in more porous biocomposite films. Fourier transform infrared spectroscopy revealed that nanocrystalline cellulose and glycerol showed good compatibility with WPI film by forming hydrogen bonds. The addition of nanocrystalline cellulose as a filler also decreased the transparency, solubility, and water vapor permeability and increased the crystallinity index of the resulting biocomposite film.