ABSTRACT

Chitosan is a biopolymer that is the focus of attention in food packaging because it is antibacterial, biodegradable, biocompatible, and non-toxic. However, chitosan's insoluble in water is a limitation of chitosan application. The method that easily increases solubility in water and can improve antibacterial properties is the modification of the structure of chitosan with the addition of hydrophilic groups that are acidic such as carboxylic acids and sulfonate to produce acid-modified chitosan products. In addition, a combination with silver nanoparticles (AgNPs) can improve the antibacterial ability of chitosan and acid-modified chitosan. This study aims to modify chitosan into acid-modified chitosan, synthesis of AgNPs-acid-modified chitosan and know the antibacterial activity of acid-modified chitosan and AgNPs-acid-modified chitosan applied in the film gelatin-whey protein. Characterization of acid-modified chitosan using FTIR and UV-VIS spectrophotometer, AgNPs composite characterization by ensuring the surface plasmon resonance (SPR) pattern using the UV-Vis spectrophotometer followed by FTIR, SEM-EDX, and AAS. The antibacterial activity uses the microdilution method to determine the minimum inhibitory concentration (MIC) of *Escherichia coli* and *Staphylococcus aureus* and antibacterial activity in vitro using filet fish with the total plate count (TPC) method. Acid-modified chitosan successfully synthesized, namely *N,O*-carboxymethyl chitosan, sulfonated chitosan, *N*-maleoyl chitosan, and *N*-phthaloyl chitosan with yields ranging from 67.97-86.09% and the degree of substitution 66.60-161.54% with sulfonated chitosan has the best reaction efficiency (yield: 86.09% and degree of substitution 161.54%). The optimum conditions of AgNPs-chitosan synthesis without the addition of external reductant and the addition of NaTPP before reduction occurred with an SPR pattern of 406 nm, particle size of 17.67 nm, and an Ag total of 64.69%. The AgNPs-sulfonated chitosan was the most optimum AgNP composite with a sharp and symmetrical SPR pattern with a maximum wavelength of 400 nm, particle size of 12.96 nm, and an Ag total of 97.73%. The antibacterial activity of AgNPs-sulfonated chitosan was strongest with MIC of 640 µg/mL (*E. coli*) and 1280 µg/mL (*S. aureus*). The AgNPs-sulfonated chitosan film was the strongest antibacterial film that prevents spoilage of fish filets.

Keywords: chitosan, acid-modified chitosan, silvernanoparticles, antibacterial, food packaging