ABSTRACT

Rifda Nur Alya. 24020221140050. **Synthesis and Characterization of Antibacterial Biopolymer Film: A Comparative Study of the Addition of Zinc Oxide (ZnO) and Zinc Chloride (ZnCl2)** under the guidance of Sri Pujiyanto and Heryoki Yohanes.

Antibacterial biopolymer films are an innovative form of active packaging that can extend the shelf life of food products by inhibiting the growth of pathogenic microorganisms. This research was conducted to synthesize and characterize biopolymer films incorporated with Zinc Oxide (ZnO) and Zinc Chloride (ZnCl2) as antibacterial agents, and to compare their effectiveness. In addition, the study aimed to analyze the effect of incorporating these two agents on the physical characteristics of the films, particularly tensile strength, and examined the correlation between surface morphology and antibacterial performance. The methodology included the synthesis of biopolymer films followed by antibacterial tests against *Staphylococcus aureus* and *Escherichia coli*, tensile strength measurements, and analysis of surface morphology using Scanning Electron Microscopy (SEM). The experimental data were statistically analyzed using one-way and two-way ANOVA, followed by a DMRT post hoc test to determine significant differences among treatments. The results indicated that the incorporation of Zinc Chloride (ZnCl2) provided a significant antibacterial effect, specifically showing effectiveness in inhibiting the growth of both *Escherichia coli* and *Staphylococcus aureus*, in both emulsion and film forms. In contrast, Zinc Oxide (ZnO) demonstrated antibacterial activity only against *Staphylococcus aureus*. The addition of ZnO and ZnCl2 at different concentrations produced varying effects on the physical characteristics of the films, particularly in tensile strength. The highest tensile strength value was observed in the sample with 3% ZnO (0.46 MPa), while the lowest value was found in the sample with 1% ZnCl2 (0.28 MPa). Increasing the concentration of ZnO acted as a reinforcing agent, whereas ZnCl2 tended to reduce the tensile strength of the films. The SEM analysis revealed a clear correlation between the surface morphology of the films and their antibacterial performance. At 2% concentration, both ZnO and ZnCl2 provided the most optimal formulation. For ZnO, this concentration resulted in a stable surface morphology with antibacterial effectiveness against Gram-positive bacteria. Meanwhile, for ZnCl2, 2% concentration provided the best balance between film structure and antibacterial activity, being effective against both Gram-positive and Gram-negative bacteria.

Keywords: *Biopolymer Film, Zinc Chloride, Tensile Strength, SEM, Staphylococcus aureus, Escherichia coli*