

## INTISARI

Kain katun merupakan salah satu serat alami yang sering digunakan sebagai bahan tekstil. Aktivitas manusia setiap harinya sering terpapar teriknya sinar matahari dimana mengandung sinar ultraviolet (UV) yang dapat mendegradasi warna tekstil. Selain itu, paparan bakteri dari keringat dan lingkungan luar dapat memberikan pengaruh kurang baik terhadap tekstil dan kesehatan manusia itu sendiri. Oleh karena itu, usaha peningkatan ketahanan warna dan higienitas tekstil dengan pewarna alami perlu diteliti. Nano ZnO/TiO<sub>2</sub> dapat memberikan sifat UV-protection karena dapat menyerap sinar UV dan sebagai antibakteri karena dapat memanfaatkan sinar UV untuk membunuh bakteri yaitu *Staphylococcus aureus* dan dihasilkan CO<sub>2</sub> dan H<sub>2</sub>O. Karakteristik nano ZnO/TiO<sub>2</sub> sesuai untuk digunakan sebagai agen antibakteri dan UV-protection. Tujuan dari penelitian ini adalah menambahkan zat aditif yaitu nano ZnO/TiO<sub>2</sub> pada kain katun yang telah diwarnai dengan pewarna alami gambir untuk meningkatkan ketahanannya terhadap mikroorganisme dan UV.

Sintesis nano ZnO/TiO<sub>2</sub> menggunakan metode sonokimia pada temperatur 30°C dan tekanan 1 atm. Pada penelitian ini variasi variabel bebas meliputi konsentrasi larutan ZnO/TiO<sub>2</sub> (30, 60, 90 ppm), persentase berat ZnO dalam ZnO/TiO<sub>2</sub> (20, 21, 22%), waktu sonikasi larutan nano ZnO/TiO<sub>2</sub> (20, 30, 40 menit) untuk mengetahui pengaruh terhadap ketahanan warna dan aktivitas bakteri pada kain katun berpewarna alami gambir yang telah dilapisi nano ZnO/TiO<sub>2</sub>. Pelapisan nano ZnO/TiO<sub>2</sub> menggunakan metode rendam yaitu merendam kain katun yang telah diwarnai oleh pewarna alami gambir pada larutan nano ZnO/TiO<sub>2</sub> selama 30 menit. Karakterisasi ukuran kristalit nano ZnO/TiO<sub>2</sub> dengan menggunakan *X-Ray Diffraction* (XRD). Analisis *Scanning Electron Microscope* (SEM) dan *Energy Disperse X-Ray Spectroscopy* (EDX) dilakukan untuk mengetahui keberadaan dan kandungan senyawa Ti dan Zn pada kain katun berpewarna alami gambir yang telah dicuci sebanyak tiga kali. Uji ketahanan warna diperlukan untuk mengevaluasi seberapa banyak warna yang ada pada serat kain katun yang telah dilapisi nano ZnO/TiO<sub>2</sub> setelah terpapar sinar UV selama 24 jam dengan menggunakan *Spectrophotometer*. Persen daya hambat aktivitas bakteri merupakan indikator untuk melihat nano ZnO/TiO<sub>2</sub> dapat menghambat bakteri yang ditandai dengan terbentuknya zona hambat bakteri disekitar sampel pada cawan petri. Melalui *Response Surface Method* (RSM) seluruh data dari uji ketahanan warna dan persen daya hambat aktivitas bakteri diolah dengan menggunakan bantuan aplikasi Minitab versi 18 untuk diperoleh interaksi antar variabel yang terkait dan kondisi optimum pada penelitian ini.

Kondisi optimum nano ZnO/TiO<sub>2</sub> sebagai UV-protection diperoleh saat persentase berat ZnO dalam ZnO/TiO<sub>2</sub> sebesar 22%, konsentrasi larutan ZnO/TiO<sub>2</sub> 90 ppm, dan waktu sonikasi larutan nano ZnO/TiO<sub>2</sub> selama 40 menit. Penambahan zat aditif nano ZnO/TiO<sub>2</sub> sebagai agen antibakteri tidak berhasil dikarenakan oleh ukuran partikel ZnO/TiO<sub>2</sub> sebesar 29,302-42,645 nm cenderung memantulkan sinar UV. Hal tersebut mengakibatkan tidak terbentuknya radikal bebas untuk merusak sel bakteri sehingga dapat menghasilkan H<sub>2</sub>O dan CO<sub>2</sub>.

Kata Kunci : Gambir, Kain Katun, Nano ZnO/TiO<sub>2</sub>, Pewarna Alami

## ABSTRACT

*Cotton fabric is one of the natural fibers that are often used as textile materials. The daily activity of people who were often exposed to sunlight which contains ultraviolet (UV) light, it is could degrade the color of textiles. In addition, the spread of bacteria could be through outside environment and sweat, it could have bad impact on textiles and human health. Therefore, development of color resistance and hygiene of textiles with natural dyes need to be investigated. Nano ZnO/TiO<sub>2</sub> could provide UV-protection properties because it could absorb UV light and could act as an antibacterial due to its capability to utilize UV light to inhibit Staphylococcus aureus bacteria's activity and produced CO<sub>2</sub> and H<sub>2</sub>O. The characteristics of nano ZnO/TiO<sub>2</sub> were suitable for antibacterial and UV-protection agents. The purpose of this research was to add additives, namely nano ZnO/TiO<sub>2</sub> on cotton fabrics that had been dyed with natural dyes gambir to increase their resistance to microorganisms and UV.*

*Synthesis of nano ZnO/TiO<sub>2</sub> used sonochemical method at a temperature of 30°C and a pressure of 1 atm. In this research, the variation of independent variables included the concentration of ZnO/TiO<sub>2</sub> solution (30, 60, 90 ppm), percentage of ZnO weight in ZnO/TiO<sub>2</sub> (20, 21, 22%), sonication time of nano ZnO/TiO<sub>2</sub> solution (20, 30, 40 minutes) to determine the effect on color resistance and bacterial activity on cotton fabric colored by gambir natural dye which had been coated with nano ZnO/TiO<sub>2</sub>. Coating of nano ZnO/TiO<sub>2</sub> used dip method, which was dipping cotton fabric that had been dyed by gambir natural dyes in nano ZnO/TiO<sub>2</sub> solution for 30 minutes. Characterization of the crystallized size of nano ZnO/TiO<sub>2</sub> was performed using X-Ray Diffraction (XRD). Scanning Electron Microscope (SEM) and Energy Disperse X-Ray Spectroscopy (EDX) analysis were needed to indicate the presence and composition of Ti and Zn compounds in cotton fabric colored by gambir natural dyes and coated by nano ZnO/TiO<sub>2</sub> which had been washed three times.*

*Color strength analysis was needed to evaluate how much color was absorbed by cotton fabric fibers that had been coated with nano ZnO/TiO<sub>2</sub> after exposing to UV light for 24 hours using spectrophotometer. Percent inhibition of bacterial activity was an indicator to observe that nano ZnO/TiO<sub>2</sub> can inhibit bacteria's activity. This inhibition was characterized by the formation of bacterial inhibition zones around the samples in petri dishes. Through Response Surface Method (RSM) all data from the color strength analysis and percent inhibition of bacterial activity were processed using application of Minitab version 18 to obtain interaction between the related variables and optimum conditions in this research. The optimum condition of nano ZnO/TiO<sub>2</sub> as UV protection was obtained when the percentage of ZnO weight in ZnO/TiO<sub>2</sub> was 22%, the concentration of ZnO/TiO<sub>2</sub> solution was 90 ppm, and the sonication time of nano ZnO/TiO<sub>2</sub> solution was 40 minutes. The addition of nano*

*ZnO/TiO<sub>2</sub> as antibacterial agents was not successful due ZnO/TiO<sub>2</sub> particle size of 29,302-42,645 nm tends to reflect UV light. It could not act to inhibit bacteria to produce H<sub>2</sub>O and CO<sub>2</sub> due to free radicals compound were not formed.*

*Keywords : Cotton fabric, Gambir, Nano ZnO/TiO<sub>2</sub>, Natural Dye*