CHAPTER IV
RESULTS AND DISCUSSION

4.1 X-ray Diffraction Characterization

Wide Angle X-ray Diffractometer (WAXD) was used to determine the protein structure as shown in Fig 4.1.

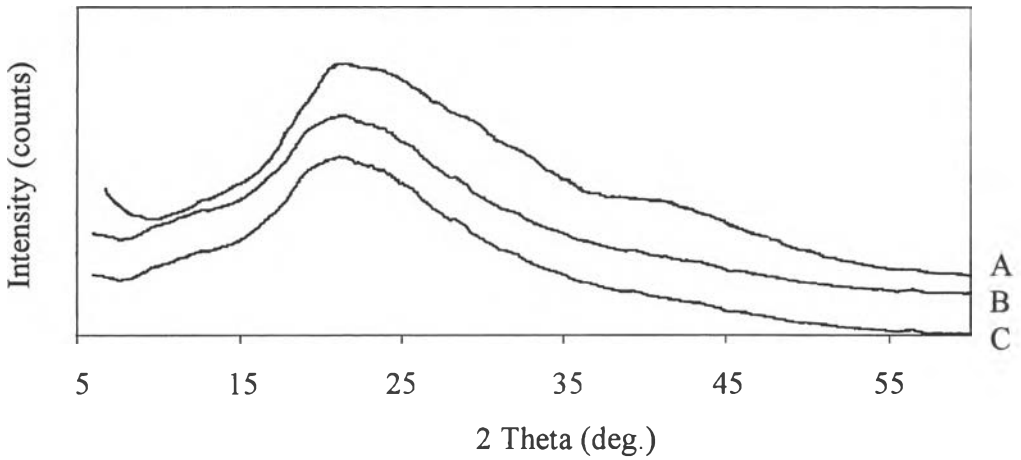


Figure 4.1 The XRD spectra of: (A) sericin Jul, (B) sericin Dok Bua, and (C) sericin Nang Noi.

The XRD spectra of each sericin showed the same trend of broad peak that means all sericin proteins have amorphous structure.

4.2 Thermal Characterization

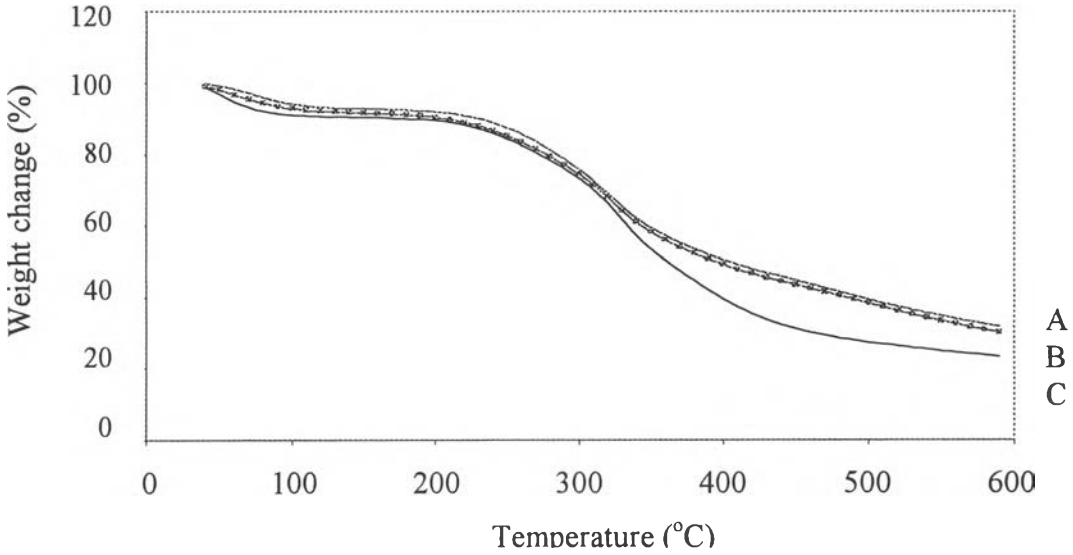


Figure 4.2 TGA thermograms of: (A) sericin Jul, (B) sericin Nang Noi, and (C) sericin Dok Bua.

From the derivative TGA thermogram curves, the decomposition temperatures of all sericins were about 315 °C.

Table 4.1 Moisture content (%) and onset temperature (°C) of sericin

Sericin	Moisture content (%)	Onset Temperature (°C)
Jul	5.66	260.8
Nang Noi	6.22	261.8
Dok Bua	7.41	270.4

4.3 FT-IR Characterization

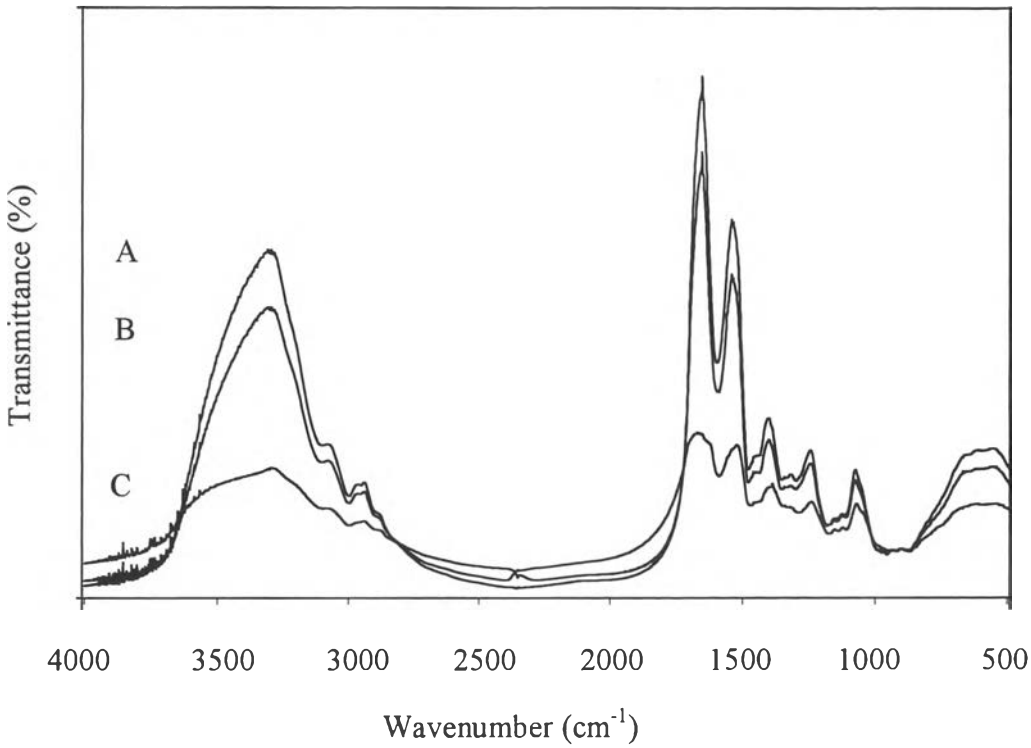


Figure 4.3 FT-IR spectra of: (A) sericin Dok Bua , (B) sericin Nang Noi, and (C) sericin Jul.

FT-IR spectra of all sericins showed NH stretching band at 3440-3420 and 1560-1530 cm^{-1}, OH stretching band at 3600 cm^{-1}, C=O stretching band at 1680-1640 cm^{-1} and C=O symmetry stretching at 1400 cm^{-1}. The interesting point was the different absorbance of each sericin. From Figure 4.3, sericin Dok Bua has the highest absorbance followed by sericin Nang Noi and sericin Jul has lowest absorbance. This can be explained by the amount of amino acid composition of each sericin. Sericin Dok Bua and sericin Nang Noi have 18 amino acids, sericin Jul has only 14 amino acids.

4.4 Morphological Characterization

The morphology and the fiber diameter of the fiber coated with sericin was investigated using SEM. The average fiber diameter of each sericin concentration was calculated from thirty SEM pictures. Figures 4.4 – 4.6 demonstrate that the Nylon and PET fiber diameters increased slightly with increased sericin concentration.

The morphology of the coated fiber was shown in Figures 4.7-4.14. It was observed that the sericin-coated fiber was smooth along with the fiber and has some joint between the two fibers that acts like glue. The micrographs reveal the fracture of sericin film indicating that sericin film is rather brittle.

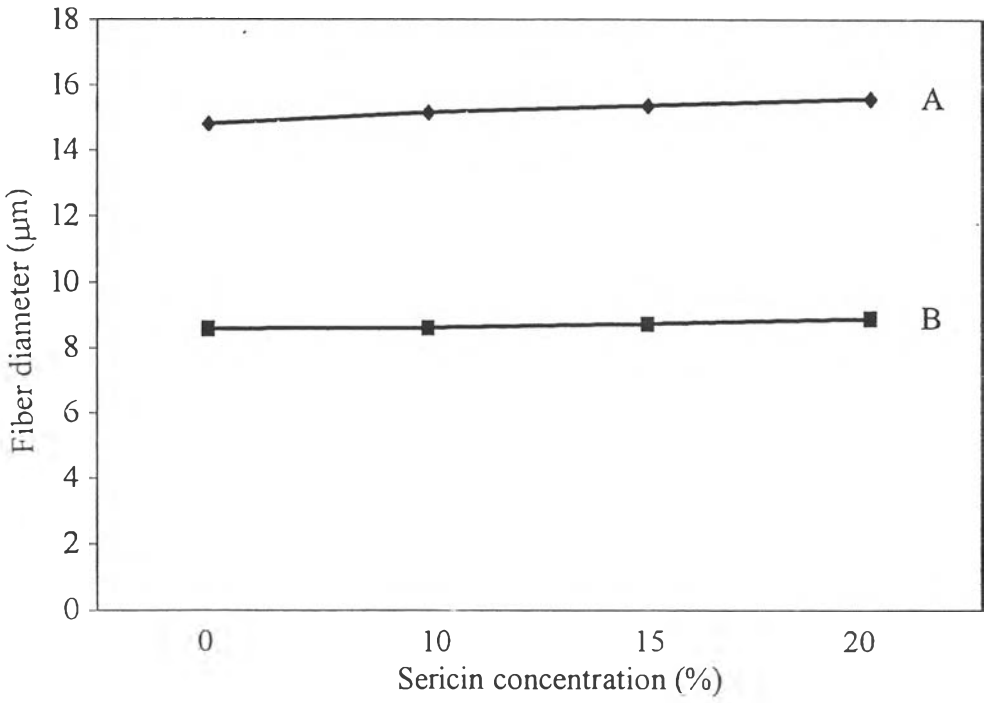


Figure 4.4 Effect of sericin Nang Noi concentration on fiber diameter: (A) Nylon fiber, and (B) PET fiber after coating.

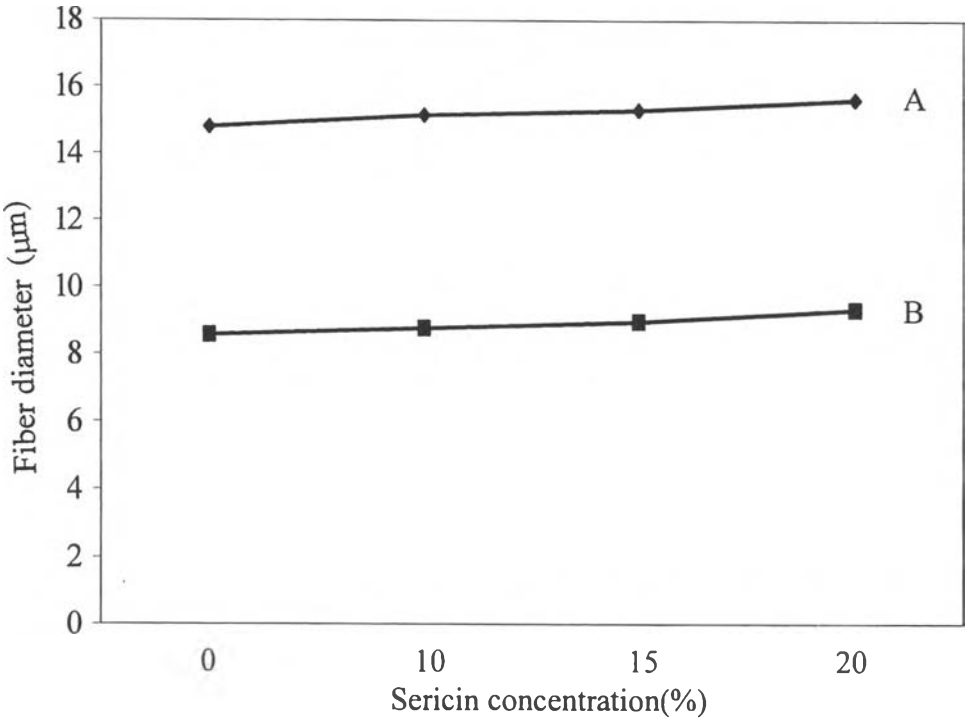


Figure 4.5 Effect of sericin Jul concentration on fiber diameter: (A) Nylon fiber, and (B) PET fiber after coating.

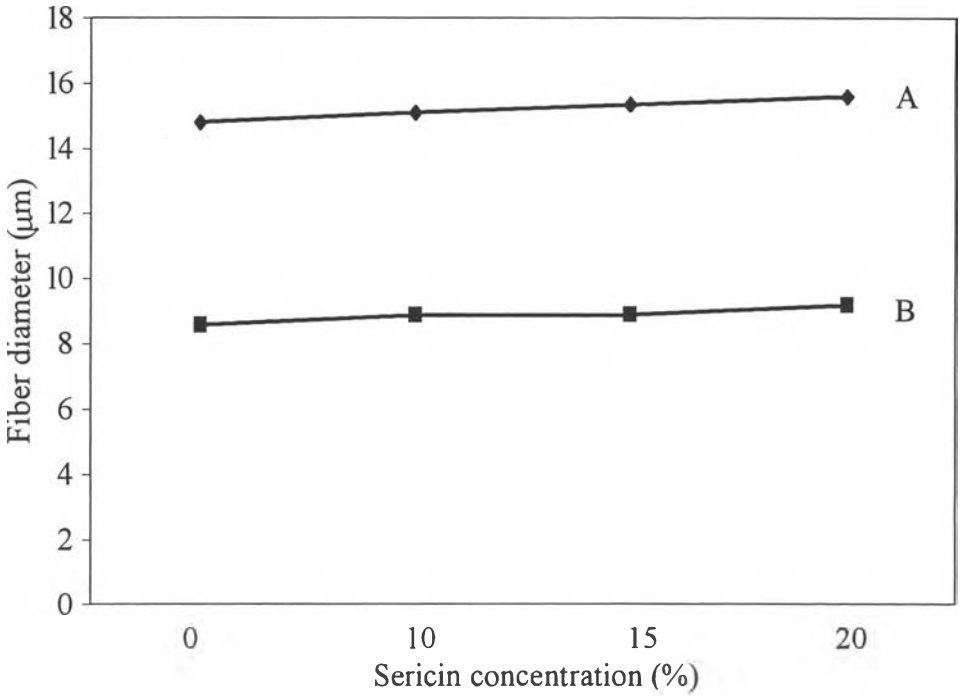


Figure 4.6 Effect of sericin Dok Bua concentration on fiber diameter: (A) Nylon fiber, and (B) PET fiber after coating.

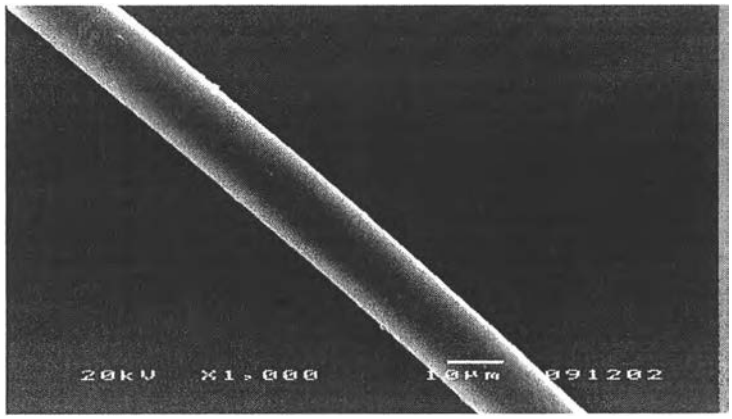


Figure 4.7 SEM micrograph of Nylon fiber before coating.

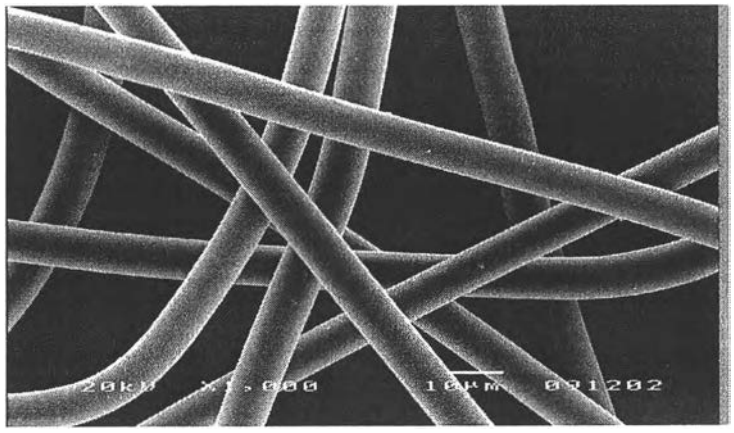


Figure 4.8 SEM micrograph of PET fiber before coating.

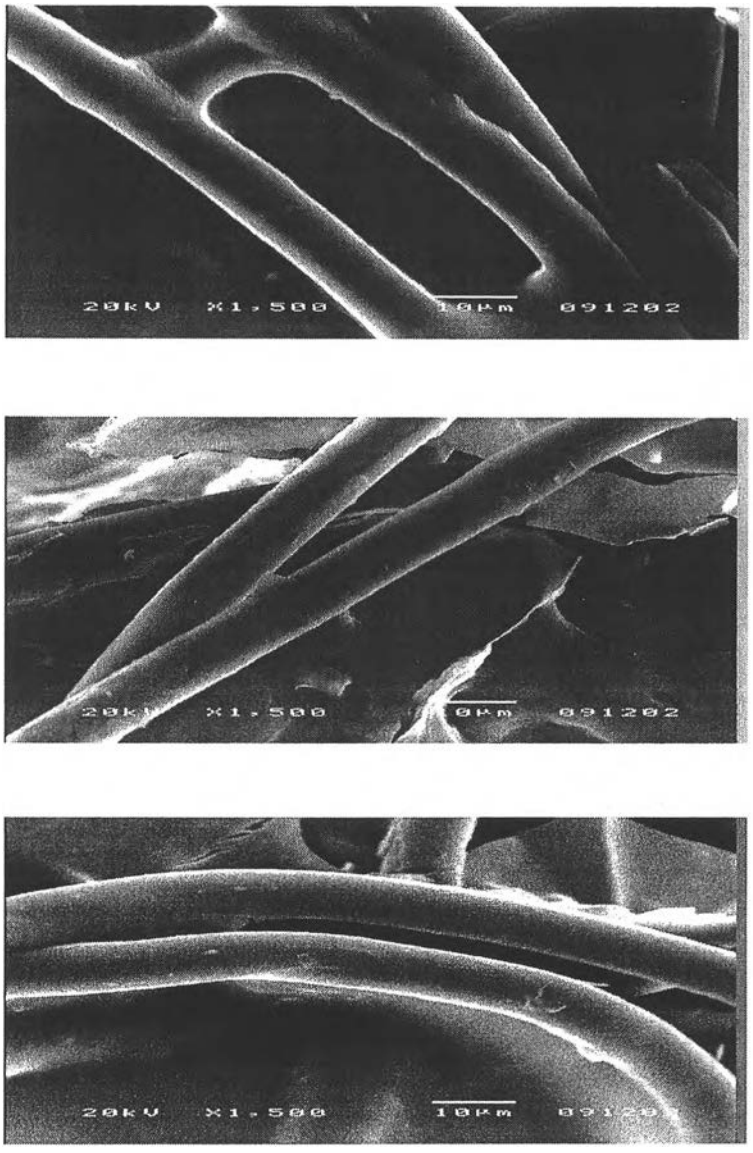


Figure 4.9 SEM micrographs of sericin Jul: (A) 10%, (B) 15%, and (C) 20% coated on PET fiber.

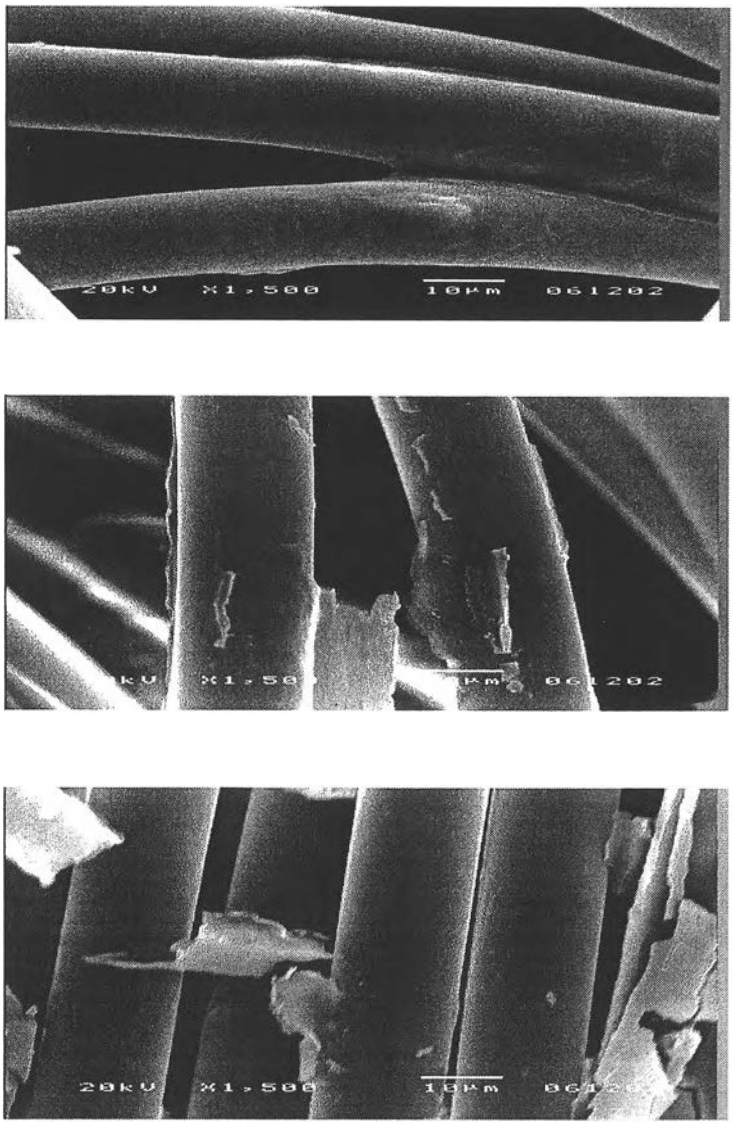


Figure 4.10 SEM micrographs of sericin Jul: (A) 10%, (B) 15%, and (C) 20% coated on Nylon fiber.

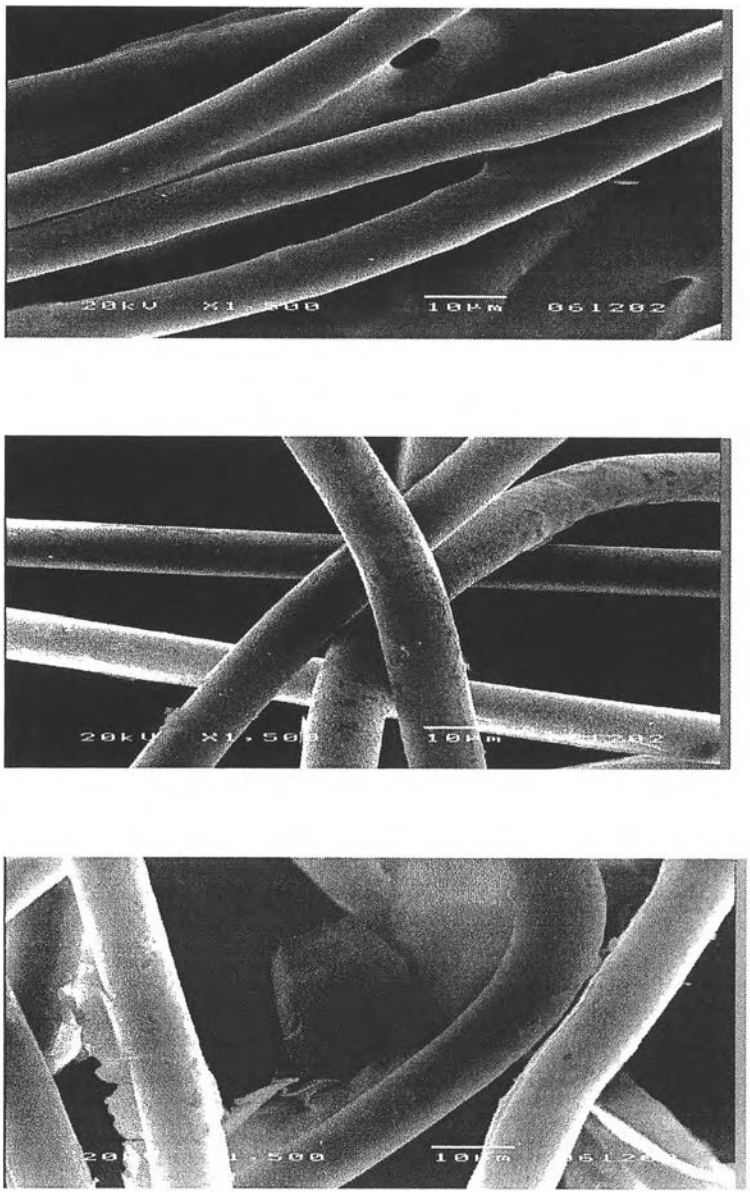
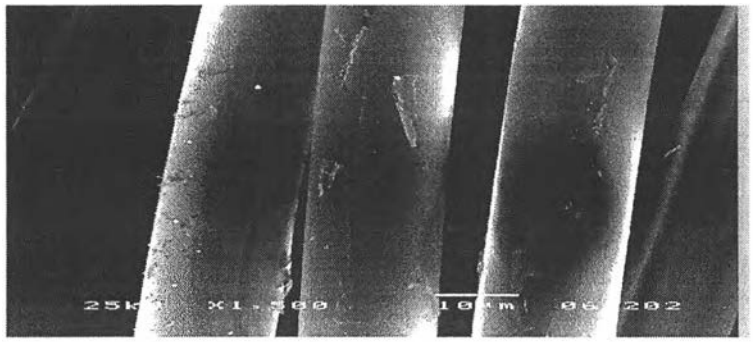
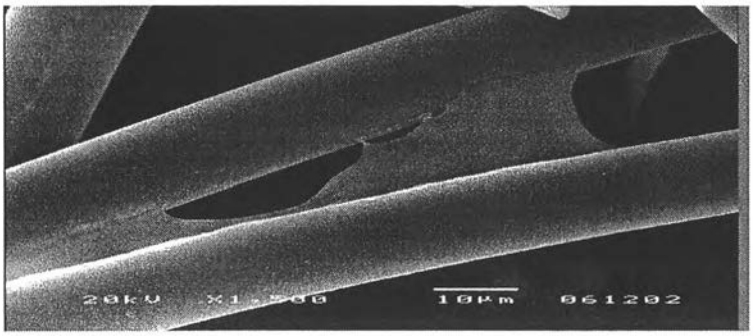


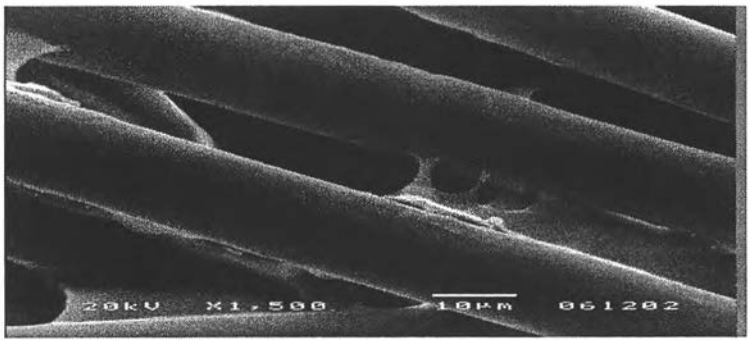
Figure 4.11 SEM micrographs of sericin Nang Noi: (A) 10%, (B) 15%, and (C) 20% coated on PET fiber.



(A)

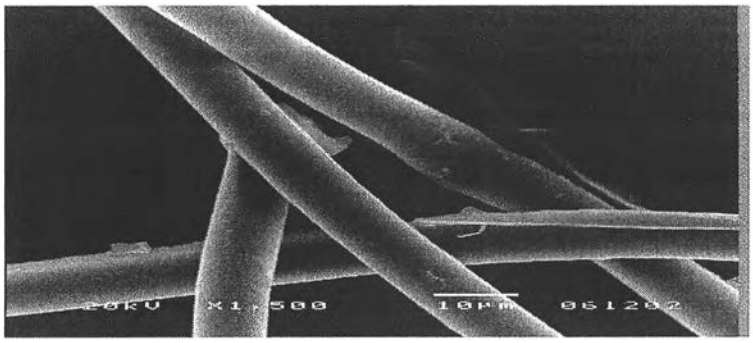


(B)

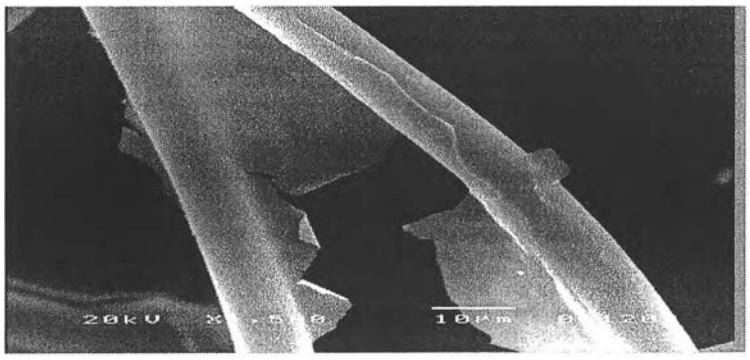


(C)

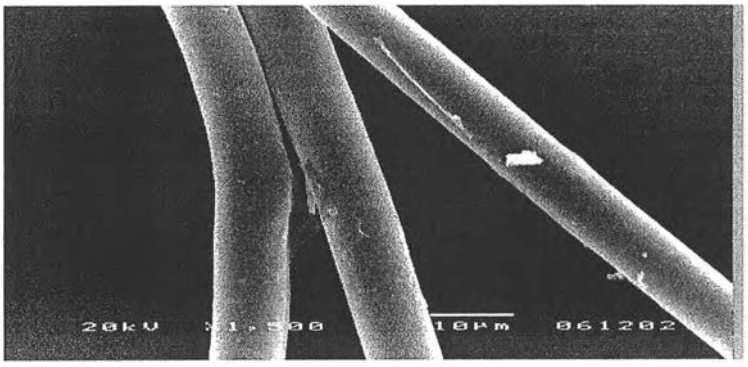
Figure 4.12 SEM micrographs of sericin Nang Noi: (A) 10%, (B) 15%, and (C) 20% coated on Nylon fiber.



(A)

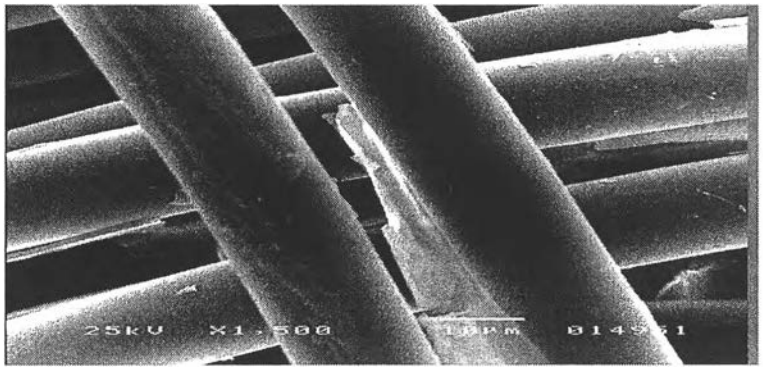


(B)

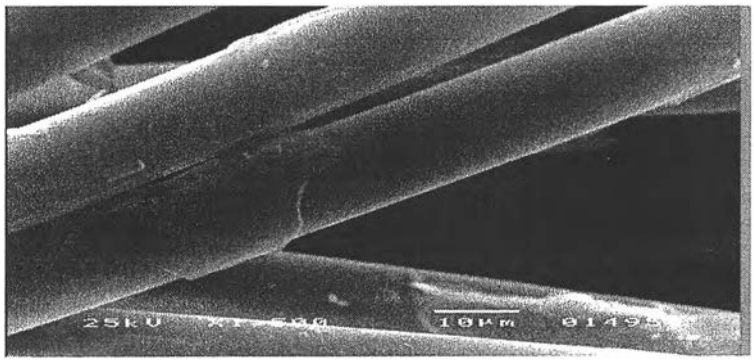


(C)

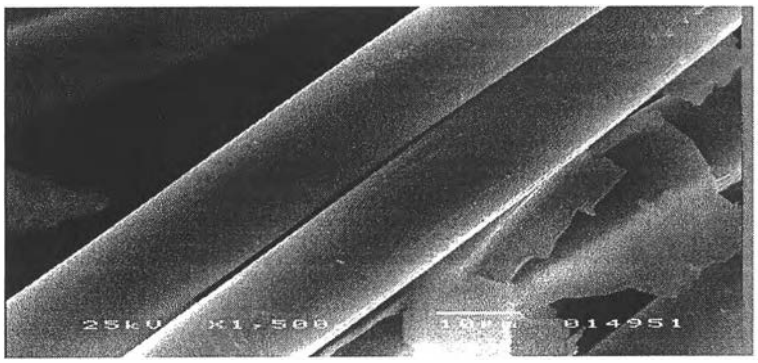
Figure 4.13 SEM micrographs of sericin Dok Bua: (A) 10%, (B) 15%, and (C) 20% coated on PET fiber.



(A)



(B)



(C)

Figure 4.14 SEM micrographs of sericin Dok Bua: (A) 10%, (B) 15% and (C) 20% coated on Nylon fiber.

4.5 Antioxidant Efficiency Characterization

The concentration of hydroxyl radicals in the reaction can be measured directly from peak area of DMPO-OH spin adducts by using ESR. A decrease in concentration of DMPO-OH spin-adduct indicates that the reaction has low concentration of hydroxyl radicals.

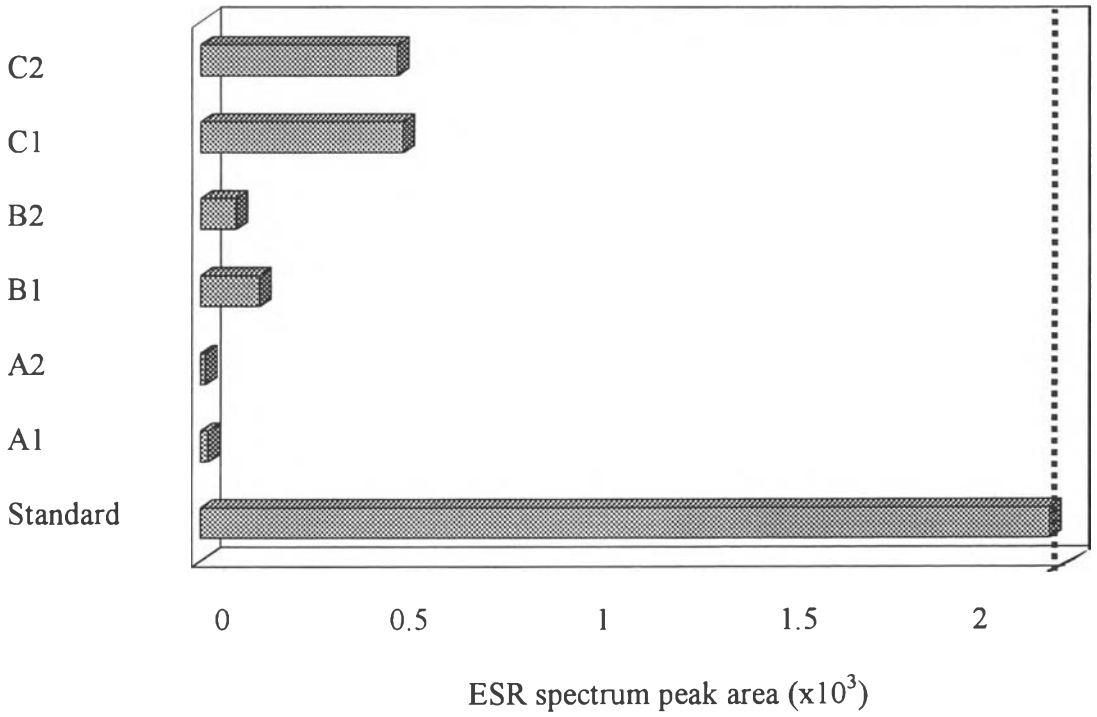


Figure 4.15 Peak areas of DMPO-OH spin adduct from ESR spectrum: (A1, A2) sericin Jul 10, and 20%, (B1, B2) sericin Dok Bua 10, and 20%, and (C1, C2) sericin Nang Noi 10, and 20% respectively.

The peak area of the standard is the initial concentration of hydroxyl radical in the reaction without sericin. Clearly sericin reduces the concentration of the hydroxyl radicals, and hence sericin has antioxidant efficiency.

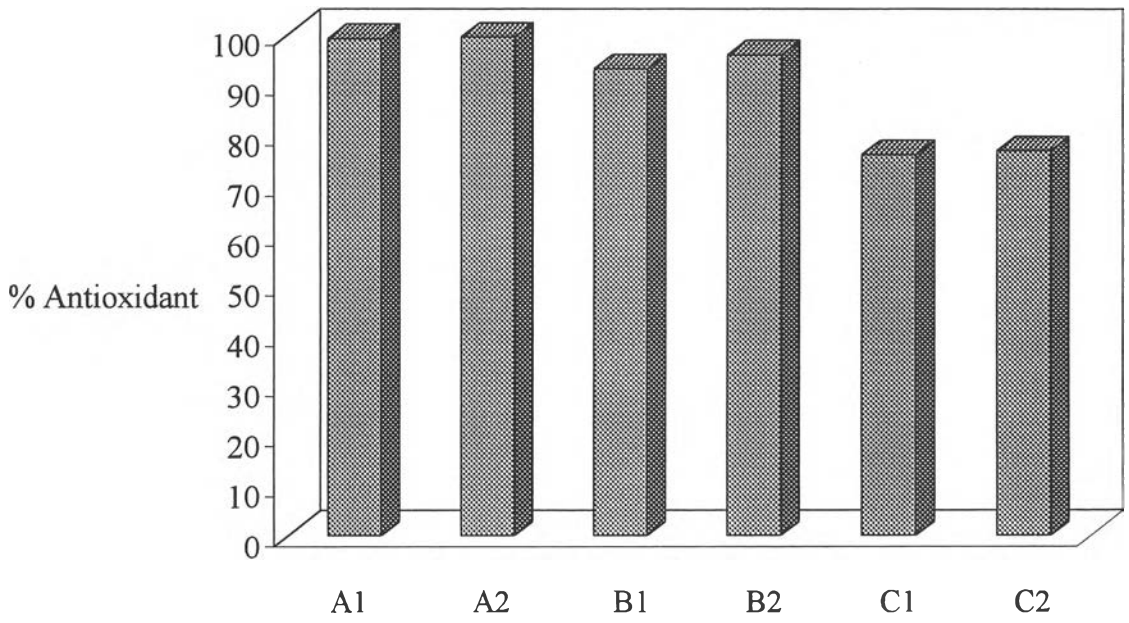


Figure 4.16 %Antioxidant efficiency of sericin: (A1, A2) sericin Jul 10, and 20%, (B1, B2) sericin Dok Bua 10, and 20%, and (C1, C2) sericin Nang Noi 10, and 20% respectively.

Figure 4.16 shows the antioxidant efficiency resulting from Figure 4.15 by using Equation 4.1.

$$\% \text{ Antioxidation} = \frac{100\%*(\text{standard peak area - sample peak area})}{\text{Standard peak area}} \qquad (4.1)$$

There is a slight increase in antioxidant efficiency with increasing sericin concentration. Sericin Jul has the highest antioxidant efficiency, followed by sericin Dok Bua, and sericin Nang Noi has the lowest antioxidant efficiency.

4.6 Antifungal Efficiency Characterization

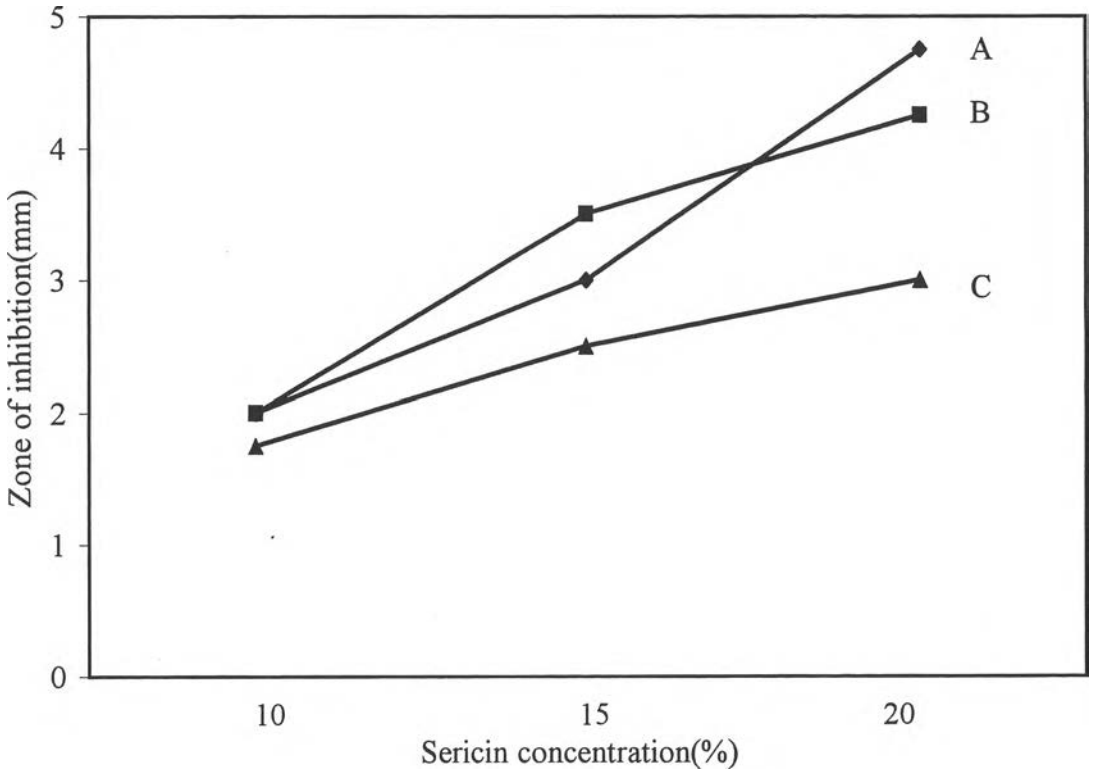


Figure 4.17 Zone of fungus inhibition of sericin: (A) sericin Dok Bua, (B) sericin Jul, and (C) sericin Nang Noi.

From Figures 4.17, from the length of fungus inhibition, sericin Dok Bua and Jul have comparable effective and Nang Noi has the lowest capacity. Furthermore, antifungal efficiency increased when the concentration of sericin increased.

4.7 Antibacterial Efficiency Characterization

It appeared from the NA plate that two types of bacteria colony was observed; the white colony (Bacillus type) which appeared around the sericin sample and the yellow colony (Micrococcus type) which appeared slightly around the sericin sample. It can be concluded that all sericin samples had no Bacillus type bacteria inhibition capacity but still had Micrococcus type inhibition capacity.

Table 4.2 Amount of micrococcus type of bacteria colony counted around sample with circle area 2.672 cm^2 and the standard area 1.850 cm

Colony counting area	Seicin Dok Bua (Colony)	Sericin Nang Noi (Colony)	Sericin Jul (Colony)
20% Sericin	4	5	2
15% Sericin	5	7	3
10% Sericin	7	12	6
Standard area	15	18	7

Figure 4.18 shows % Antibacterial (Micrococcus type) of sericin obtained by using Equation 4.2.

$$\% \text{ Antibacterial} = \frac{100-(100*\text{colony from sample area})}{\text{colony from standard area}} \qquad (4.2)$$

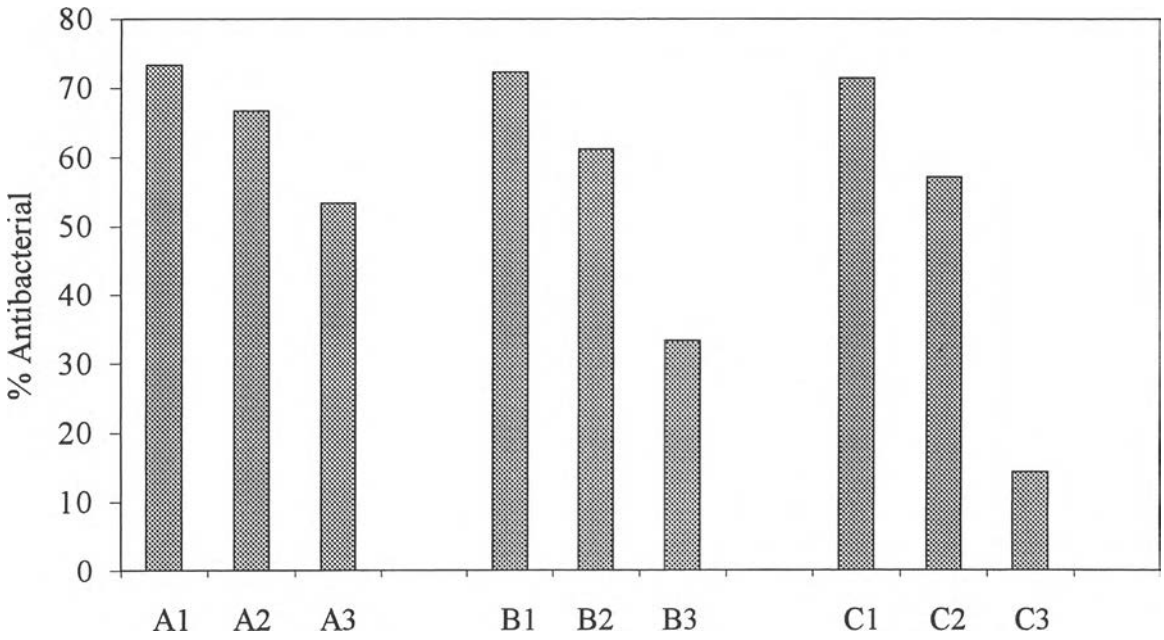


Figure 4.18 % Antibacterial (micrococcus type) of sericin: (A1, A2, A3) sericin Dok Bua 10, 15, and 20%, (B1, B2, B3) sericin Nang Noi 10, 15, and 20%, and (C1, C2, C3) sericin Jul 10, 15, and 20% respectively.

From Figure 4.18, the antibacterial efficiency increased when the concentration of sericin increased. Furthermore, from the amount of bacteria colonies, sericin Dok Bua had the highest antibacterial capacity, while Nang Noi was second and Jul had the lowest capacity.