Fine Structure of the Silk Fibroin-based Scaffolds derived from the Orb-web Spider *Trichonephila clavata*

Yan SUN[1], Bon-Jin KU[1] , and Myung-Jin MOON[1]

[1]Department of Biological Sciences, Dankook University, Cheonan, Korea

ABSTRACT

- Compared with other biopolymers, spider silk can significantly reduce inflammation and serve as a scaffold for cell culture enable to growth of different cell types.
- In this experiment, the silk solution of the major ampullate gland and tubuliform gland in the orb-web spider *Trichonephila clavata* were made into silk fibroin film and hydrogels, then compared with the cocoon of silkworm *Bombyx mori*.
- The cytocompatibility and cytotoxicity of silk fibroin films and hydrogels were also determined by LDH assays.
- The β-sheet content of the spider major ampullate gland silk film is higher, and it is less soluble in water.
- The surface of the spider major ampullate gland silk film is relatively rough, at the same time, the porosity of the hydrogel made from the spider silk protein of the large ampulla gland was 62.55%, the thickness of the pore wall was approximately 3.5~5.0 ㎛, and the tiny fibers on the walls of the pores, so the cell adhesion is strong.
- The hydrogel made of tubuliform gland spider silk protein has an average porosity of 52.65% and a pore wall thickness of 1.5-3.5 ㎛.
- These can improve the desirability of spider silk materials in in vitro cell culture and regeneration bioengineering.

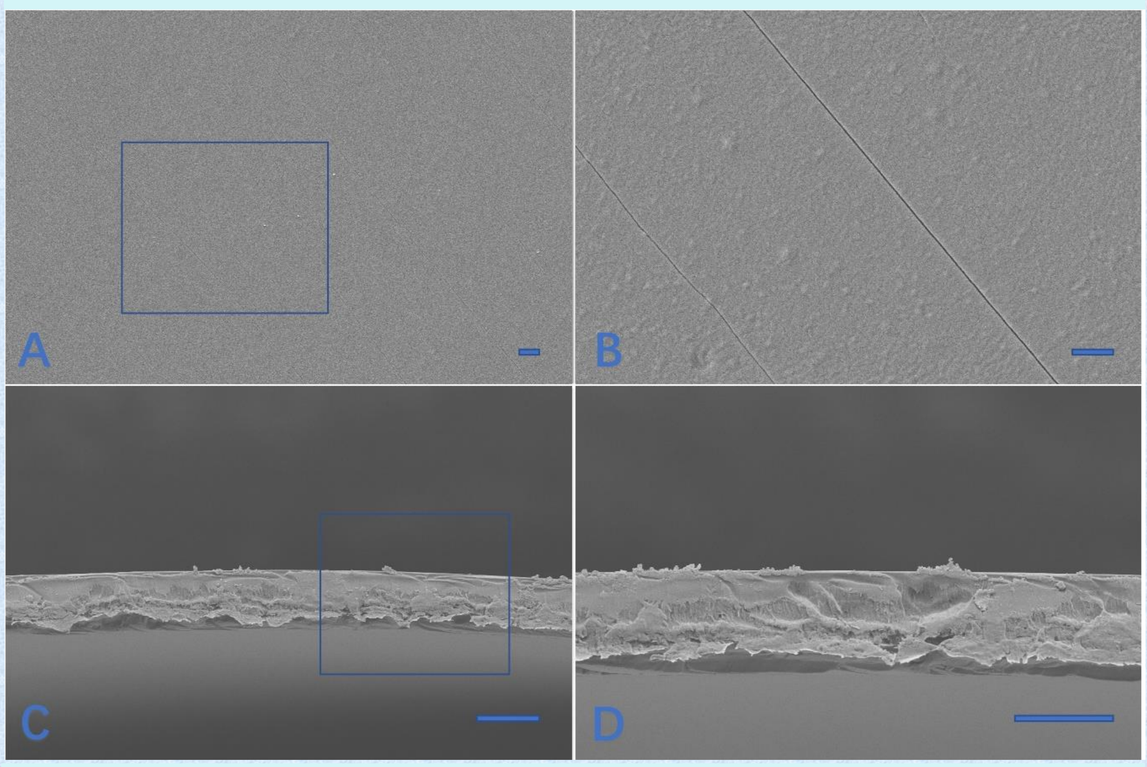

Figure 7. **Scanning electron micrographs of the silkworm film scaffold. A, B:** The surface of the silk fibroin film with same interval partitions**. C, D:** The cross-sectional structure of the film. Scale bars indicate 1 μm (B), 2 μm (A) and 10 μm (C, D).

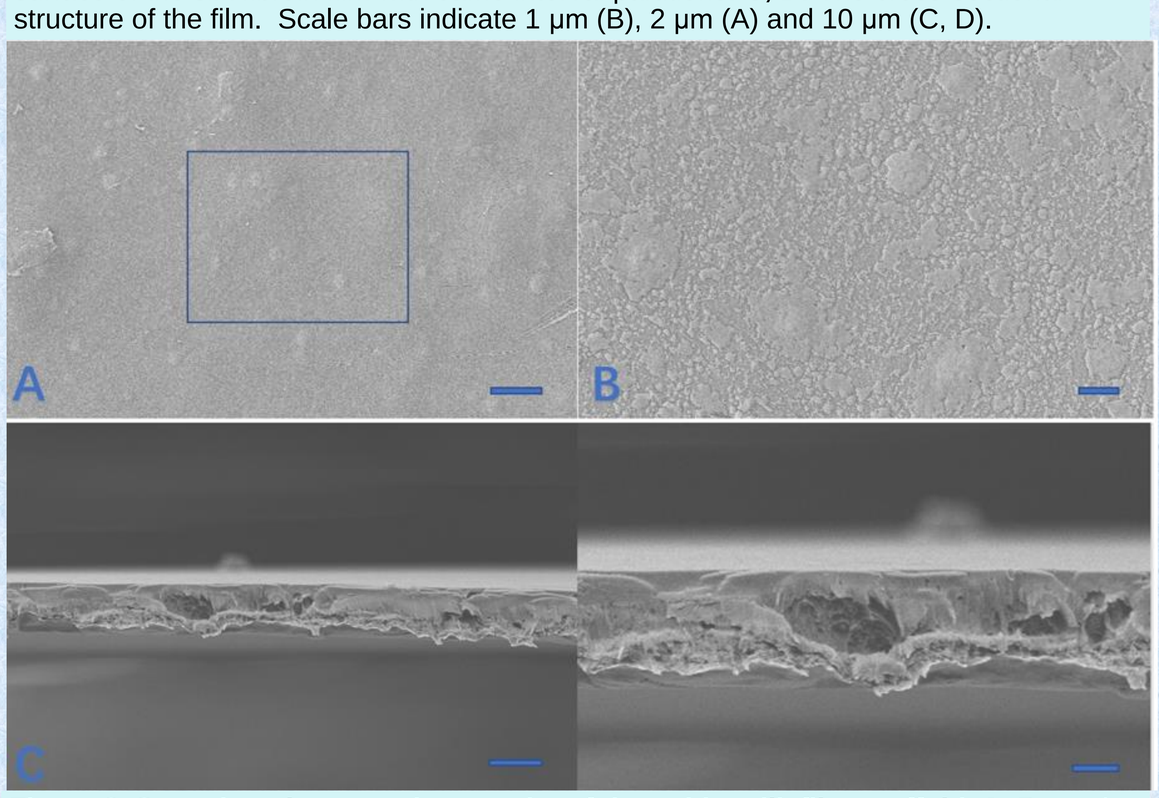

Figure 8. **Scanning electron micrographs of the spider silk film scaffold. A, B** are the surface structure of the mixed film of of spider silk protein solution from the tubuliform gland. **C,D:** the cross-sectional structure of the film. Scale bars indicates 1 μm (B) ; 5 μm (A); 10 μm (C,D).

Figure 6. **Scanning electron micrographs of the spider silk film scaffold. A, B** are the surface structure of the mixed film of spider silk protein solution from the major ampullate gland. **C,D**: the cross-sectional structure of the film. Scale bars indicates 1 μm (B) ; 5 μm (A); 10 μm (C,D)

RESULTS

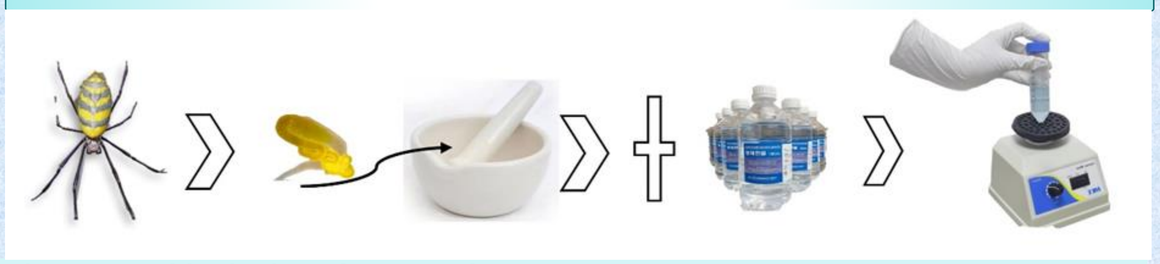

Figure 1. Spider hydrogel preparation process.

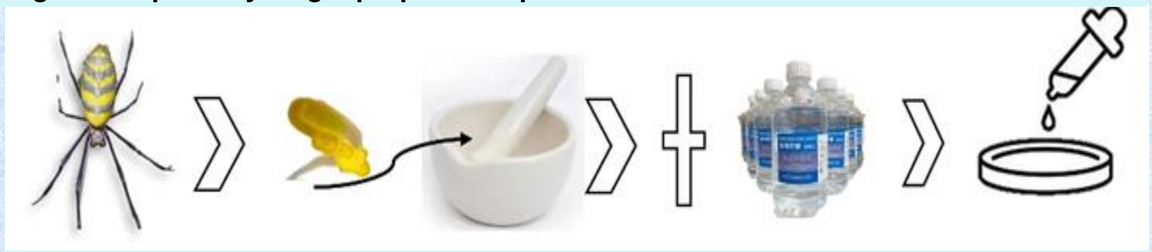

Figure 2. Spider film preparation process.

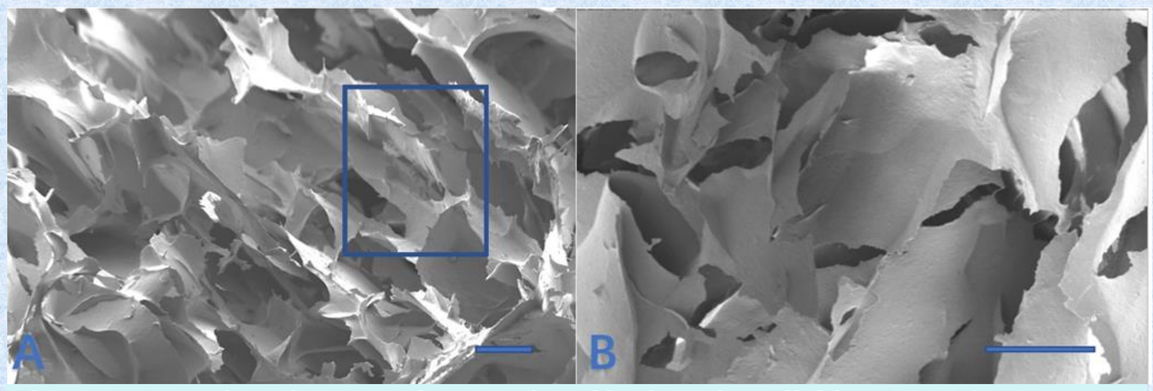

Figure 3. Scanning electron micrographs of hydrogel scaffolds. A, B: The porous hydrogel scaffold made of spider tubulifrom gland and silkworm silk fibroin solution in a ratio of 1:3. The average porosity of spider's scaffold is 52.65% and thickness of pore walls in the range of 1.5–3.5 ㎛. Scale bars all indicates100 μm.

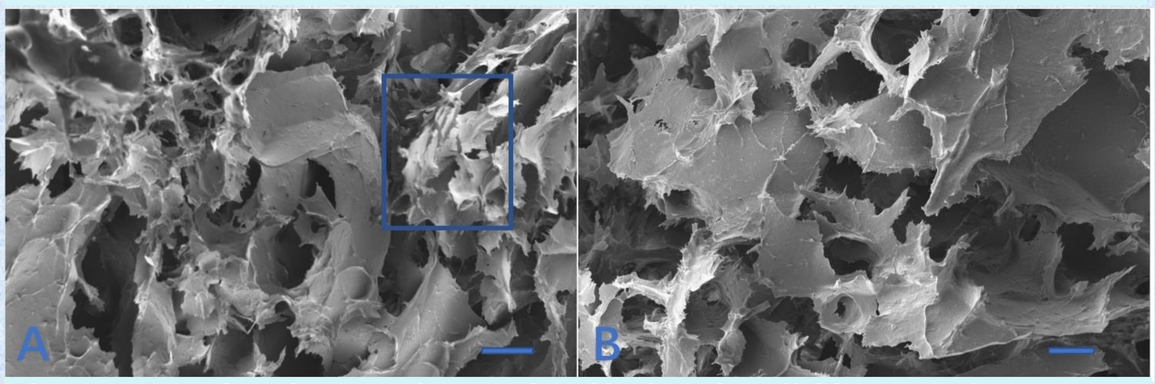

Figure 4. Scanning electron micrographs of hydrogel scaffolds. A, B: The porous hydrogel scaffold made of spider major ampullate gland and silkworm silk fibroin solution in a ratio of 1:3. The average porosity of spider's scaffold is 62.55% and thickness of pore walls in the range of 3.5–5 ㎛. Scale bars indicates 20 μm (B), 100 μm (A).

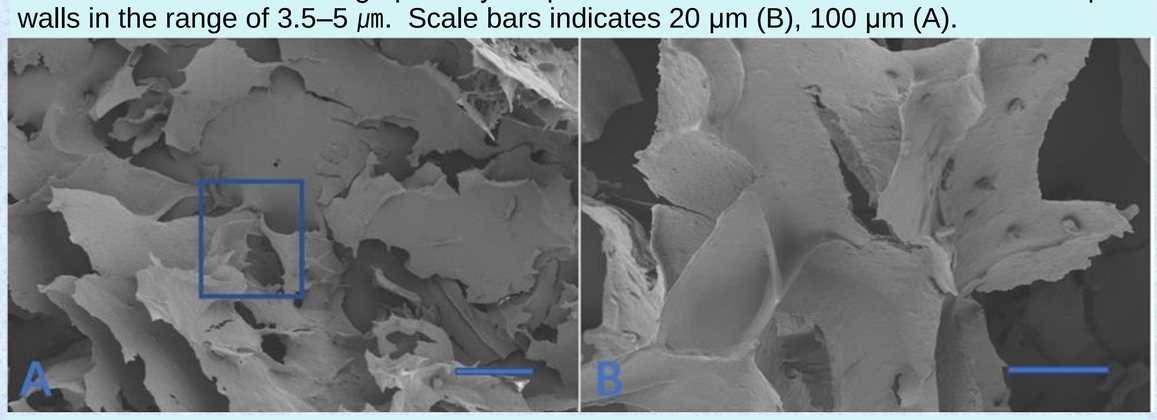

Figure 5. Scanning electron micrographs of silkmoth's silk hydrogel scaffolds. A, B: The average porosity of silkmoth silk scaffold is 52.14%, thickness of pore walls in the range of 4.5–6.5 ㎛. Scale bars indicates 50 μm (B); 100 μm (A).