Silk Analysis of Silkworms Fed Microcrystalline Cellulose and Cellulose Acetate

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Creating biodegradable materials is imperative as plastic pollution contributes to global warming. A promising biodegradable material is silk because of its strength. To further enhance its properties, silk has been combined with other materials. The most effective and least intrusive method of combination is by feeding silkworms functional materials. However, the combination of silk with other naturally strong fibers, particularly cellulose, remains a challenge and has not been sufficiently investigated. This study fed Bombyx mori silkworms cellulose acetate (CA) and microcrystalline cellulose (MCC) in different concentrations (0.2%, 2.0%, and 4.0%) to investigate how a natural polymer affects the properties of silk. The silkworms were separated into seven groups of fourteen and each group was fed mulberry leaves brushed with a different concentration of CA or MCC. Silkworm health was not adversely affected, as there was no significant difference in the cocoon dimensions or cocooning rates across groups, and there was a 98% larvae survival rate. Fourier transform infrared spectroscopy showed the presence of cellulose and changes in the second structure composition of silk. Fourier self deconvolution and curve fitting results revealed that the beta sheet content of all cellulose groups increased, with the 2.0% MCC group having as high as a 31% increase in intermolecular beta sheet content. Scanning electron microscopy indicated that the cellulose reinforced the silk fibers. This is an affordable method of combination as well, therefore making the large-scale production of more biodegradable materials feasible.