Production of Large Spider Dragline Silk Proteins in *Escherichia coli* by Metabolic Engineering

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Spider dragline silk is a remarkably strong fiber that makes it attractive for numerous applications. Much has thus been done to make similar fibers by biomimic spinning of recombinant dragline silk proteins. However, success is limited in part due to the inability to successfully express native-sized recombinant silk proteins (250-320 kDa). Here we show that a 284.9-kDa recombinant protein of the spider *Nephila clavipes* is produced and spun into a fiber displaying mechanical properties comparable to those of the native silk. The native-sized protein, predominantly rich in glycine (44.9%), was favorably expressed in metabolically engineered *Escherichia coli* within which the glycyl-tRNA pool was elevated. We also found that the recombinant proteins of lower molecular weight versions yielded inferior fiber properties. The results provide insight into evolution of silk protein size related to mechanical performance, and also clarify why spinning lower molecular weight proteins does not recapitulate the properties of native fibers. [This work was supported by the Converging Research Center Program (2009-0082332) of the Ministry of Education, Science, and Technology (MEST) through the National Research Foundation (NRF).]