

IMPRS on Multiscale Biosystems

Biochemical approach to study biomaterials: link between protein matrix nature to mechanical properties in spider cuticles.

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Project description: The arthropod cuticle is an ordered fibrous composite that serves as skin and skeleton. It also comprises the specialized working tools and sensory organs. The arthropod cuticle is composed of chitin fibers embedded in protein matrix. The matrix is composed of different proteins, many of which are known to contain conserved sequences responsible for the specific and strong binding of the chitin fibers. The mechanical properties of the cuticle are dependent on many factors amongst these are the chitin-protein ratios, the type of proteins, the degree of sclerotization and, in some specialized cuticular parts, by the occurrence of metal ions.

Despite their importance for the cuticle mechanical properties, there is little information about the sequences and structure of these matrix proteins, especially, of the protein(s) involved in metal binding. In the light of increased interest in biomimetic materials in general, and in structural metallo-proteins in particular, we believe that a biochemical understanding of the natural system is of pivotal importance. The main objective of the proposed research is to identify and characterize cuticular proteins with mechanical/structural functions. Our model system is the spider *Cupiennius salei*. The first step of the project includes extraction, purification and partial sequencing of cuticular proteins. In the second step, we will use molecular biology approaches to obtain genetic sequences of the full length proteins and use these for the subsequent structural and mechanical characterization.

Our research bears significance for both the biological community as a basic study for comprehensive understanding of the arthropod cuticle, and for materials scientists, as understanding of the naturally occurring materials may inspire design of new synthetic material with multiple functionalities.

References:

[1] Politi, Y., Priewasser, M., Pippel, E., Zaslansky, P., Hartmann, J., et al. (2012) Adv. Funct. Mater. **22**, 2519

[2] A C. Neville , D. A. Parry , J. Woodhead-Galloway (1976) J. Cell Sci **21**, 73

[3] Erko, M., Hartmann M. H., Zlotnikov, I., Valverde Serrano, C., Fratzl, P., and Politi, Y. (2013) J. Struc. Biol. 183, 172

Required background: The candidate should have a strong background in biochemistry. Experience in biochemistry, molecular biology and bioinformatics is an advantage. The candidate should also be motivated to learn and apply biophysical characterization techniques.

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