

A fatty acid-binding protein links lipid handling to chitin synthase-dependent cuticle formation and nanoscale organization in *Tribolium castaneum*

Marius Beck*

Department of Chemistry-Biology, University of Siegen, Siegen, Germany

*Email: Marius.beck@uni-siegen.de

The insect cuticle is a chitin-containing extracellular matrix whose formation requires coordinated chitin biosynthesis, fibril organization, and maturation. Although lipids are essential for cuticle barrier function, their connection to chitin synthase-dependent cuticle formation remains poorly understood. Building on previous work in *Drosophila*, we identified *Tribolium castaneum* Fabp homologs and prioritized TcFabp8 by phylogenetic analysis and qualitative TcChs1 co-immunoprecipitation/mass spectrometry. RNAi-mediated *TcFABP8* depletion caused severe molting and cuticular defects, including reduced cuticle thickness and chitin deposition and loss of apical TcChs1 immunoreactivity, while TcCHS1 transcript levels were not markedly reduced. TcFabp8 localized to subapical punctate structures and developing cuticle associated with Nile Red-positive lipid-rich compartments. Synchrotron X-ray diffraction showed preserved α -chitin-associated peak positions but reduced chitin-associated diffraction intensity and altered fibrillar anisotropy. These data identify TcFabp8 as a functional link between lipid handling, TcChs1-dependent chitin deposition, and nanoscale cuticle organization.