Squid sucker ring teeth material could aid reconstructive surgery, serve as eco-packaging

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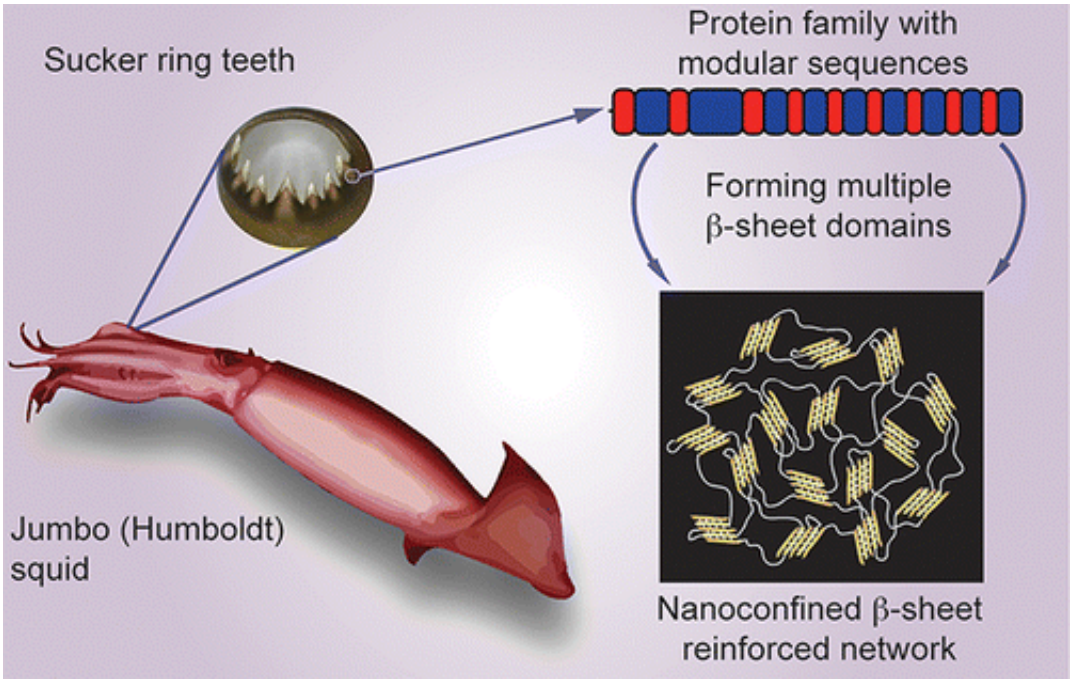

Squid tentacles are loaded with hundreds of suction cups, or suckers, and each sucker has a ring of razor-sharp "teeth" that help these mighty predators latch onto and take down prey. In a study published in the journal *ACS Nano*, researchers report that the proteins in these teeth could form the basis for a new generation of strong, but malleable,

materials that could someday be used for reconstructive surgery, eco-friendly packaging and many other applications.

Ali Miserez and colleagues explain that in previous research, they discovered that sharp, tough squid sucker ring teeth (SRT) are made entirely of proteins. That makes SRT distinct from many other natural polymers and hard tissues (such as bones) that require the addition of minerals or other substances to perform the right activities, they say. The team already had identified one "suckerin" protein and deciphered its genetic code. They also found that this protein could be remolded into different shapes. But what about the other suckerins in SRT?

In the new study, they identified 37 additional SRT proteins from two squid species and a cuttlefish. The team also determined their architectures, including how their components formed what is known as "ß-sheets." Spider silks also form these structures, which help make them strong. And just as silk is finding application in many areas, so too could SRT proteins, which could be easier to make in the lab and more eco-friendly to process into usable materials than silk. "We envision SRT-based materials as artificial ligaments, scaffolds to grow bone and as sustainable materials for packaging, substituting for today's products made with fossil fuels," says Miserez. "There is no shortage of ideas, though we are just beginning to work on these proteins."

More information: Nanoconfined ß-Sheets Mechanically Reinforce the Supra-Biomolecular Network of Robust Squid Sucker Ring Teeth, *ACS Nano*, Article ASAP. DOI: 10.1021/nn502149u

Abstract
The predatory efficiency of squid and cuttlefish (superorder Decapodiformes) is enhanced by robust Sucker Ring Teeth (SRT) that perform grappling functions during prey capture. Here, we show that SRT are composed entirely of related structural "suckerin" proteins

whose modular designs enable the formation of nanoconfined β-sheet-reinforced polymer networks. Thirty-seven previously undiscovered suckerins were identified from transcriptomes assembled from three distantly related decapodiform cephalopods. Similarity in modular sequence design and exon–intron architecture suggests that suckerins are encoded by a multigene family. Phylogenetic analysis supports this view, revealing that suckerin genes originated in a common ancestor 350 MYa and indicating that nanoconfined β-sheet reinforcement is an ancient strategy to create robust bulk biomaterials. X-ray diffraction, nanomechanical, and micro-Raman spectroscopy measurements confirm that the modular design of the suckerins facilitates the formation of β-sheets of precise nanoscale dimensions and enables their assembly into structurally robust supramolecular networks stabilized by cooperative hydrogen bonding. The suckerin gene family has likely played a key role in the evolutionary success of decapodiform cephalopods and provides a large molecular toolbox for biomimetic materials engineering.

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