The BC component of ABC toxins is an RHS-repeat-containing protein encapsulation device.

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ABC toxin complexes are a class of large, multi-subunit protein complexes produced by bacteria. They are widespread in pathogens of insects, and are also present in several mammalian pathogens[1]. These complexes typically contain three major protein components[2], TcA, TcB, and TcC. The TcA component forms a pentameric assembly that is responsible for binding to the target cell and stimulating endocytosis. The TcC protein contains two distinct regions, a conserved N-terminal region (TcC^{NTR}) and a variable C-terminal toxin region (TcC^{CTR}). When co-expressed with TcB, the TcC protein is cleaved at the junction between these two regions, and all three polypeptides remain tightly associated.

I have studied the ABC toxin complex from a native New Zealand soil bacterium, *Yersinia entomophaga*[3]. I have determined the structure of several of the proteins that make up the complex, including two chitinase enzymes[4] and the complex formed by the TcB and TcC^{NTR} proteins. The TcB/TcC^{NTR} structure revealed an unprecedented, large, hollow shell with a previously unknown protein fold[5]. This shell is formed from a long strip of β-sheet that spirals around a central cavity, ~59,000 $Å^3$ in volume. This hollow shell is believed to encapsulate the cytotoxic TcC^{CTR} and deliver it into the cell cytoplasm.

The TcC proteins contain a conserved "RHS-repeat-associated core domain." We show that this domain is an aspartic protease that cleaves the TcC protein into its two component regions, with TcC^{CTR} encapsulated inside the shell.

TcC proteins also contain RHS (rearrangement hot-spot) repeats, which can be found throughout bacterial species, and also in eukaryotes as the related YD repeats. This is the first structure of a protein containing RHS repeats, and we are able to describe their three-dimensional structure. Each individual RHS repeat corresponds to an individual strand-turn-strand, and we predict that multiple RHS repeats will form a long strip of β-sheet that spirals around to form a hollow shell, as seen in our structure. RHS repeat proteins are therefore likely to be involved in the encapsulation and delivery of C-terminal peptides.

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