Carbohydrate-carbohydrate Interactions in Cell Aggregation of Marine Sponges

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Introduction: Sponges (Porifera) are ancient and simplest metazoans. They constitute key organisms in the evolution of the multicellular animals. Cell-cell adhesion and recognition in sponges are mediated by proteoglycan-like molecules (aggregation factors, AF’s) composed of a protein core attached to several units of sulfated polysaccharides. Both cell adhesion and recognition are effectively accomplished by homophylic and calcium-dependent interactions among the sulfated polysaccharides of the AF’s. The aim of the present work was investigate the chemical nature of these interactions using modified sulfated polysaccharides from the marine sponge *Desmapsamma anchorata*.

Methods and Methods: Isolation of AF’s (DAF) and sulfated polysaccharides (DASP) from *D. anchorata* were performed by ion exchange chromatography and serial centrifugation, respectively. Structural characterization of DASP was made by CG-MS, NMR and chemical analysis. DASP was chemically modified to remove sulfate esters residues (des-DASP) and to remove carboxylic acid residues (cr-DASP). Affinity chromatographies of native and modified DASP’s were performed using a Sepharose CL-4B-DASP column. Image of DAF was taken by atomic force microscopy (AFM). Binding forces of native and modified DASP’s were measured by single molecule force spectroscopy (SMFS).

Results: DAF contains glucose (~90%), hexuronic acid (~10%) and ~1.5 sulfate esters per sugar unit. The AFM image of DAF shows that it is composed by tens DASP unities attached to a circular protein core. The affinity chromatographies showed that DASP and cr-DASP but not des-DASP interact with DASP. These results were confirmed by SMFS, DASP and cr-DASP showed average binding forces of 230 pN whereas des-DASP did not show measurable binding forces. All these interactions only occur in the presence of calcium. Conclusions: These results indicate that homophylic interactions of AF’s are accomplished by a calcium bridge between sulfated carbohydrates. The emerging of proteoglycan-like molecules in the cell surface may had promoted the raise of the first metazoans.


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