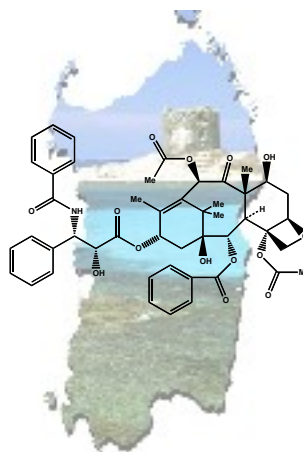




## SardiniaChem2008

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DELLE MOLECOLE BIOLOGICAMENTE ATTIVE

30 Maggio 2008, Aula Magna della Facoltà di Scienze – Sassari



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## GLYCOSAMINOGLYCAN DIVERSITY IN MARINE SPONGE EXTRACELLULAR MATRIX

[M. Formato](#), [A.J. Lepedda](#), [§F.D. Ledda](#), [A. Cigliano](#), [E. Zinellu](#), [§R. Pronzato](#), [G.M. Cherchi](#),  
[°R. Manconi](#)

Dipartimento di Scienze Fisiologiche, Biochimiche e Cellulari, Università di Sassari

§Dipartimento per lo Studio del Territorio e delle sue Risorse, Università di Genova

°Dipartimento di Zoologia e Genetica Evoluzionistica, Università di Sassari

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The composition in sulphated polysaccharides from the sponge extracellular matrix (ECM) is almost unknown with few exceptions, although pharmacological activities tested as anti-inflammatory and anti-viral drugs, have been recently discovered (Cimino et al., 2001). In the evolutive history of the kingdom Animalia the extracellular matrix (ECM) appeared firstly in the phylum Porifera, being Protista unable to produce the fundamental matrices to support the existence of a pluricellular organism (Morris, 1993). Sponges are the lowest eukaryotic multicellular organisms and their body plan architecture can be described as a glycoproteic jelly containing independent and mobile cells in a network of fibrous protein honeycombed by canals (mesohyl) (Garrone, 1978, 1985). The extracellular matrix of these primitive metazoans resembles that of higher taxa, being composed of collagen, proteoglycans (PGs), and minor amounts of structural proteins and glycosaminoglycans (GAGs) (Garrone, 1978, 1985; Simpson, 1984; Morris, 1993; Müller, 1995). Moreover, structure and function of extracellular matrices depend on interactions between anionic glycosaminoglycans (Scott, 2001). Proteoglycan-like molecules are involved in cell-cell interaction and species-specific cell re-aggregation (MacLennan, 1970; Müller et al., 1982; Junqua et al., 1981; Spillmann et al., 1995; Misevic et al., 1982). The structural features and biological roles of sulphated glycans in the ECM of sponges are however poorly known. About twenty years ago it was discovered that sponges are able to produce hyaluronic acid (HA), dermatan sulfate (DS), chondroitin 4-sulfate (C4S), chondroitin 6-sulfate (C6S) and heparin (Evans and Bergquist, 1977; Cassaro and Dietrich, 1977).

Aim of this paper is to report on a screening on sponge ECM glycosaminoglycan (GAG) diversity. To investigate the heterogeneity of sponge extracellular sulphated glycans, we determined their content and distribution in some Mediterranean and Caribbean species. To focus on biological and morpho-functional roles of these molecules in the sponge ECM some selected species were considered as models to investigate the topographic distribution of GAGs in sponge body according with the different architecture of specialized regions. Sulphated polysaccharides were extracted by proteolytic treatment from specimens preserved in absolute ethanol and subjected to both quantitative and qualitative analyses by standard methods. Most samples displayed a notable amount in sulphated polysaccharides, with an extremely wide range in their content at different taxonomic levels confirming that species-specific variations in both GAG chemical composition and molecular masses occur in different species (Zierer and Mourao, 2000). From the qualitative point of view, we detected that sponge GAGs do not fit the standards used for vertebrates, therefore they are not suitable substrata for specific enzymatic reactions able to degrade GAGs from vertebrates as reported by different authors (Katzman and Jeanloz, 1970; Katzman et al.,

1970; Misevic et al., 1990) and as confirmed by their resistance to specific eliminase degradation (chondroitin-lyases and hyaluronidase). These findings strongly suggest a lower sulphation degree associated with a different sugar composition, substitution and sequential arrangement compared with classical GAGs. The astonishing diversity of sulphated polysaccharides could be related to a wide adaptive radiation in the structural and functional organization of sponge ECM. Some taxa display sulphated polysaccharides with peculiar electrophoretic patterns, however this trait appears to be not exclusive of each taxon. Sponge GAGs need a deeper structural characterisation in order to test their potential as molecular markers. Our aim for the future is to investigate their role in the applicative field for pharmacological activities and as sources of biomaterials.

#### References

- Cassaro C.M.F., Dietrich C.P. 1977. Distribution of sulfated mucopolysaccharides in invertebrates. *J. Biol. Chem.* 252 (7): 2254-2261.
- Cimino P., Bifulco G., Casapullo A., Bruno I., Gomez-Paloma L., Riccio R., 2001. Isolation and NMR characterization of rosacelose, a sulfated polysaccharide from the sponge *Mixilla rosacea*. *Carbohydr. Res.* 334: 39-47.
- Evans C.W., Bergquist P.R. 1977. A re-evaluation of the relevance of acid mucopolysaccharides in sponge taxonomy. *Cahiers Biol. Mar.* 18: 191-199.
- Garrone R. 1978. Phylogenesis of Connective Tissue. Morphological aspects and biosynthesis of sponge intercellular matrix. In: *Frontiers of Matrix Biology*, Vol. 5, Robert L.(Ed), S. Karger, Basel, pp. 1-248.
- Garrone R. 1985. Biology of invertebrates and lower vertebrates collagens. New York, Bairati A., Garrone R. (Eds), pp. 157-182.
- Junqua S., Lemonnier M., Robert L. 1981. Glycoconjugates from *Spongia officinalis* (Phylum Porifera). Isolation, fractionation, by affinity chromatography on lectins and partial characterization. *Comp. Biochem. Physiol.* 69B: 445-453.
- Katzman R.L., Jeanloz R.W. 1970. The carbohydrate chemistry of invertebrate connective tissue. In: Tristram R.G., Balazs E.A. (Eds.), *Chemistry and molecular biology of the intercellular matrix*, Academic Press Inc., New York, pp. 217-227.
- Katzman R.L., Lisowska E., Jeanloz R.W. 1970. Invertebrate Connective Tissue. Isolation of D-Arabinose from sponge acidic polysaccharide. *Biochem. J.* 119: 17-19.
- MacLennan A.P. 1970. Polysaccharides from sponges and their possible significance in cellular aggregation. In: Fry, W.G., (Ed.), *The biology of Porifera. Symp. Zool. Soc. Lond.*, Academic Press, London 25: 299-324.
- Misevic G.N., Jumblatt J.E., Burger M.M. 1982. Cell binding fragments from a sponge proteoglycan-like aggregation factor. *J. Biol. Chem.* 257: 6931-6936.
- Misevic G.N., Burger M.M. 1990. Involvement of a highly polyvalent Glycan in the cell-binding of the aggregation factor from the marine sponge *Microciona prolifera*. *J. Cell. Biochem.* 43(4): 307-314.
- Morris P.J. 1993. The developmental role of the extracellular matrix suggests a monophyletic origin of the kingdom Animalia. *Evolution* 47(1): 152-165.
- Müller W.E.G. 1995. Molecular phylogeny of Metazoa (Animals): monophyletic origin. *Naturwissenschaften* 82: 321-329.
- Müller W.E.G., Zahn R.K., Bernd A., Dawes K., Müller I., Uhlenbruck G., Dorn A. 1982. Molecular basis of cell-cell recognition: isolation, synthesis, and function of an aggregation complex from the sponge *Geodia cydonium*. *Cell. Rec.* 809-816.
- Scott J.E. 2001 Structure and function in extracellular matrices depend on interactions between anionic glycosaminoglycans. *Pathol. Biol.* 49: 284-289.
- Simpson T.L. 1984. *The cell biology of sponges*. Springer-Verlag, New York.
- Spillmann D., Thomas-Oates J.E., van Kuik J.A. Vliegert-hart J.F.G., Misevic G., Burger M.N., Finne J. 1995. Characterization of a novel sulphated carbohydrate unit implicated in the carbohydrate-carbohydrate-mediated cell aggregation of the marine sponge *Microciona prolifera*. *J. Biol. Chem.* 270: 5089-5097.
- Zierer M.S., Mourao P.A.S. 2000. A wide diversity of sulphated polysaccharides is synthesized by different species of marine sponges. *Carbohydr. Res.* 328: 209-216.