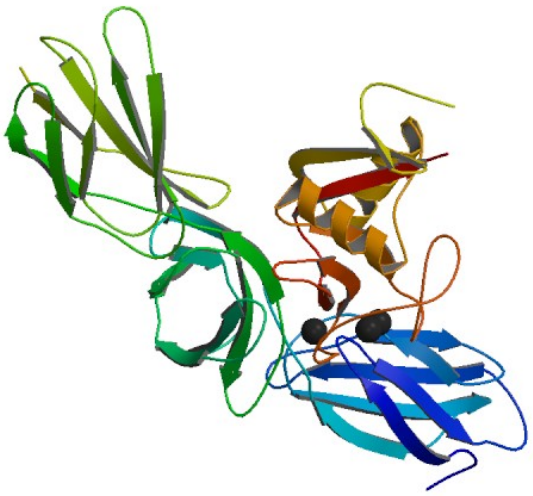
Proteoglycan

Not to be confused with bacterial peptidoglycan.

Proteoglycans are proteins[1] that are heavily glycosylated. The basic proteoglycan unit consists of a "core protein" with one or more covalently attached glycosaminoglycan (GAG) chain(s).[2] The point of attachment is a Ser residue to which the glycosaminoglycan is joined through a tetrasaccharide bridge (For example: chondroitin sulfate-GlcA-Gal-Gal-Xyl-PROTEIN). The Ser residue is generally in the sequence -Ser-Gly-X-Gly- (where X can be any amino acid residue), although not every protein with this sequence has an attached glycosaminoglycan. The chains are long, linear carbohydrate polymers that are negatively charged under physiological conditions, due to the occurrence of sulfate and uronic acid groups. Proteoglycans occur in the connective tissue.



Aggrecan, the major proteoglycan in cartilage, has 2316 amino acids

Types

Proteoglycans can be categorised depending upon the nature of their glycosaminoglycan chains. Proteoglycans can also be categorised by size (kDa).

Types include:

Glycosaminoglycans	Small proteoglycans	Large proteoglycans
chondroitin sulfate/dermatan sulfate	decorin, kDa=36 biglycan, kDa=38	versican, kDa=260-370, present in many adult tissues including blood vessels and skin
heparan sulfate/chondroitin sulfate	testican, kDa=44	perlecan, kDa=400-470
chondroitin sulfate		neurocan, kDa=136 aggrecan, kDa=220, the major proteoglycan in cartilage
keratan sulfate	fibromodulin, kDa=42 lumican, kDa=38	

Certain members are considered members of the "small leucine-rich proteoglycan family" (SLRP).[3] These include decorin, biglycan, fibromodulin and lumican.

Function

Proteoglycans are a major component of the animal extracellular matrix, the "filler" substance existing between cells in an organism. Here they form large complexes, both to other proteoglycans, to hyaluronan and to fibrous matrix proteins (such as collagen). They are also involved in binding cations (such as sodium, potassium and calcium) and water, and also regulating the movement of molecules through the matrix. Evidence also shows they can affect the activity and stability of proteins and signalling molecules within the matrix. Individual functions of proteoglycans can be attributed to either the protein core or the attached GAG chain and serve as lubricants.

Synthesis

The protein component of proteoglycans is synthesized by ribosomes and translocated into the lumen of the rough endoplasmic reticulum. Glycosylation of the proteoglycan occurs in the Golgi apparatus in multiple enzymatic steps. First a special link tetrasaccharide is attached to a serine side chain on the core protein to serve as a primer for polysaccharide growth. Then sugars are added one at a time by glycosyl transferase. The completed proteoglycan is then exported in secretory vesicles to the extracellular matrix of the cell.

Proteoglycans and disease

An inability to break down proteoglycans is characteristic of a group of genetic disorders, called mucopolysaccharidoses. The inactivity of specific lysozomal enzymes that normally degrade glycosaminoglycans leads to the accumulation of proteoglycans within cells. This leads to a variety of disease symptoms, depending upon the type of proteoglycan that is not degraded.

References

[1] MeSH *Proteoglycans* (http://www.nlm.nih.gov/cgi/mesh/2011/MB_cgi?mode=&term=Proteoglycans)

[2] Gerhard Meisenberg; William H. Simmons (2006). *Principles of medical biochemistry* (http://books.google.com/books?id=y2A0h64iNlcC&pg=PA243). Elsevier Health Sciences. pp. 243–. ISBN 9780323029421. . Retrieved 6 February 2011.

[3] Hans-Joachim Gabius; Sigrun Gabius (February 2002). *Glycosciences: Status and Perspectives* (http://books.google.com/books?id=G0DiximLj5YC&pg=PA209). John Wiley and Sons. pp. 209–. ISBN 9783527308880. . Retrieved 6 February 2011.

External links

- Diagram at nd.edu (http://www.nd.edu/~aseriann/proteogly.html)
- Diagram at usip.edu (http://tonga.usip.edu/gmoyna/biochem341/lecture35.html)

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