Секция «Химия»

Structure and biological functions of the glycosaminoglycans and proteoglycans

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The extracellular matrix (ECM) of multicellular animals is a complex gel-like network that surrounds cells and plays a crucial role in maintaining tissue integrity, providing mechanical support, and facilitating the diffusion of nutrients and oxygen [1]. The ECM is primarily composed of fibrous proteins, including collagens, elastins, and fibronectins, together with a diverse group of heteropolysaccharides known as glycosaminoglycans (GAGs). Glycosaminoglycans are linear polymers consisting of repeating disaccharide units typically composed of an amino sugar—either N-acetylglucosamine or N-acetylgalactosamine—and a uronic acid such as D-glucuronic acid or L-iduronic acid [1, 2]. Most glycosaminoglycans are sulfated and covalently attached to core proteins to form proteoglycans, whereas hyaluronan is nonsulfated and does not form covalent linkages with proteins.

Among these polymers, hyaluronan is distinguished by its exceptionally high molecular weight and lack of sulfation. It forms highly viscous, noncompressible solutions that function as lubricants in synovial fluid and contribute to the gel-like structure of the vitreous humor of the eye. In connective tissues such as cartilage and tendons, hyaluronan interacts noncovalently with other ECM components, contributing to tensile strength and elasticity [3]. Other major glycosaminoglycans, including chondroitin sulfate, dermatan sulfate, keratan sulfate, and heparan sulfate, differ from hyaluronan in polymer length, structural composition, and covalent association with core proteins [4]. These molecules play essential roles in maintaining the mechanical properties of tissues such as cartilage, skin, blood vessels, and cornea. Additionally, sulfated glycosaminoglycans participate in important biological processes through their ability to interact with a wide range of proteins [5]. For example, heparan sulfate binds growth factors, enzymes, and extracellular matrix components, influencing cell signaling and tissue organization. A highly sulfated intracellular form, heparin, is widely used as a therapeutic anticoagulant due to its ability to enhance the activity of the protease inhibitor antithrombin.

Overall, glycosaminoglycans and their associated proteoglycans are fundamental structural and regulatory components of the extracellular matrix, contributing significantly to tissue physiology, cell signaling, and various biomedical applications.

Источники и литература

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