

# 생체단백질의 생체재료화

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## Biological Proteins as Biomaterials

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According to the progress of engineering science, many of artificial organs have been introduced. It is a common sense that every substance which contacts to natural tissue should be biocompatible, and every artificial tissue replacement must be consisted of biocompatible materials so called biomaterials.

There are 3 types of biomaterials. Synthesized materials such as alloys, ceramics, synthetic polymers *et. al.* have been widely applied due to their various advantages, but they are not viable. With concerning viability, there are the other researchers who have tried to utilize biological materials as like natural proteins, polysaccharides and cells as biomaterials, but it is extremely difficult to reconstruct their vitality as materials, for the critically vital environment must be kept. To overcome disadvantages of the both of the aboves, some composites which are consisted of synthized and biological materials are introduced.

In general, tissues are composed of the ground substances mainly consisted by polysaccharide and minerals, in which the protein rich intertwining fibrous networks maintain structural frames, on which cells are living.

As one of the main organic components of body with polysaccharides and lipids, proteins are widely existing in body as fibrous structural components, blood plasma proteins, enzymes, growth factors.

Protein is a polymerized amino acids which form peptide, a polyamide produced by polymerization between carboxyl and amino groups. The basic concept of applying proteins as biomaterials is to provide cellular fuctions to materials, for examples, growth factors to induce cellular proliferations, and extra cellular matrices for cell adhesions.

Collagen is the main fibrous structural component of organs and tissues, promotes cell adhesion, cell growth, and tissue regeneration. There are 14 types

of collagens with known structures, and the basic peptide sequence of them is - X - Gly - Pro - Hyp - Gly - X - , which forms a left handed single helical peptide chain so called an  $\alpha$  - chain. A tropocollagen is a right handed triple  $\alpha$ -chain coiled helix. The well known highly insoluble collagen structure is stabilized by interaction between  $\alpha$  - helices through hydrogen bonds between C=O and NH groups, ionic bonds between side groups of the polaric amino groups, and by interchain cross links.

The specific immune reaction of collagen is related to the telopeptides, which are non helical portions, and are located at the both extremities of collagen molecules. They are terminating each other to form intermolecular cross links. If the telopeptides were destroyed by denaturation, collagen demonstrates no immune responses and called as an atelocollagen. In these days, the atelocollagen is the main biological protein substance which is applied to various kinds of artificial tissues, such as skin substitute, esophagus, trachea, hemostatic agent, bone composite, membrane, etc.

Fibronectin is a cell adhesive protein. The RGD (Arg - Gly - Asp) sequence unit acts as a ligand which adheres to the receptor on cell membrane.

This characteristics can be applied to biomaterials especially to provide blood biocompatibility as an antithrombogenic agent in blood environment by binding to the receptors on platelets prior to the occurrence of platelet-material surface interaction as an antagonist. On the other hand, fibronectin can be used as a cell adhesive agent on polymer surface. The grafted RGD - ligand on a polymer surface adheres to the receptors on cell membrane, and provides a favorable environment for cell proliferation.

Cell growth factors, non-nutritional substances promoting cell growth *in vivo*, are also no ignorable proteins in body. NGF (neural cell), EGF (epithelial cell), FGF (fibroblast), PDGF (platelet derived), IGF(insulin), CDF (cartilage derived), HGF (hepatic cell), LDGF (leukemia cell derived), TDGF (trophoblast derived), 45K-GF (platelet derived), BMP(bone morphogenic protein), TGF-b (transforming growth factor-b) are introduced specific cell growth factors. By using these proteins, we can induce the specific cell growth and proliferation to the specific part.