Research Article

Guiding the Differentiation Direction of Pancreatic Islet-Derived Stem Cells by Glycated Collagen

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1. Introduction

Stem cell differentiation was directed not only by soluble biofactors but also by other factors in the microenvironment of stem cells. The physical aspects, like surface topography [1], stiffness [2], shear stress [3], and light [4], have been shown to guide the differentiation as well. Therefore, surface modification by coating is preferred to control surface roughness and hydrophobicity to stabilize cell attachment and promote cell differentiation [5]. Coating the surface with collagen, laminin, or synthetic polypeptides is the ordinary application in the culture of cells on smooth surfaces, like glass, on which cells loosely bind. In some cases, the coating enables the culture of specific cells, like the feeder-free culture of embryonic stem cells. By designing peptide chains with different length and composition, it was also possible to determine the fate of cell differentiation [6].

In certain circumstances, proteins can also undergo spontaneous modifications in vivo and contribute to age-related diseases. Under the hyperglycolytic conditions, for example, the proteins experience nonenzymatic posttranslational modification leading the formation of advanced glycation end-products (AGEs). Type 1 diabetic patients are especially susceptible to AGE formation. The oxidative condition caused by the accumulation of AGEs in the tissue might lead to biophysical disorders, like Alzheimer, cardiovascular diseases, diabetes, and renal failure [7]. The AGEs, which were formed with age due to the hyperglycemia and hyperlipidemia, are known to change the collagen and other extracellular matrix proteins in tissues [8].

In this study, collagen type 1 was modified by glycation. The effect of this nonenzymatic alteration with four monosaccharides (glucose (G), mannose (M), arabinose (A), and rhamnose (R)) on the cell morphology and the direction of the differentiation was analyzed. The primary aim was to demonstrate the biological effects of the modified collagen by glycation with various monosaccharides on stem cell response and differentiation.