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Opinion Article

Bioreactor System and its Important Component in the Process of Tissue Engineering

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DESCRIPTION

The bioreactor system is an important component in the process of 3D tissue engineering and the formation of tissue structures. Bioreactors are used to provide a tissue-specific *in vitro* physiological environment during tissue maturation. Various tissue systems can be cultured *in vitro* based on bioreactor technology. This chapter provides an overview of the different types of bioreactor applications used during the tissue engineering process. It shows the basic principles and requirements for bioreactor development. The use of bioreactor systems to expand clinically relevant tissue types is covered. In particular, bioreactors for connective tissue engineering are being discussed. The potential to generate tissue systems that can culture and provide some degree of mechanical stimulation and growth factor regulation has been demonstrated. Computational analysis of bioreactors was performed to understand mechanical stimuli and the environment. During the *in vivo* maturation process, mechanical factors are important in establishing tissue function. These factors include hydrostatic pressure and shear stress, which are important for understanding histogenesis. A new perfusion bioreactor was created to understand the mechanical stimulation properties of cartilage tissue. This bioreactor was designed to hold a scaffold and utilize fluid flow. Here, mechanical stimuli are applied to the tissue structure, a continuous supply of fresh oxygen-rich medium, and the removal of waste products produced by continuous cellular metabolic activity. The system flow was optimized using flow simulation. Additional hydrostatic pressure, shear stress, and turbulence were monitored during flow fluctuations to correlate the relationships and estimate the final process characteristics.

BIOREACTOR SYSTEM IMPORTANCE IN 3D TISSUE ENGINEERING

Bioreactor systems are a vital component in the process of 3D tissue engineering and the formation of tissue constructs. Based on the bioreactor technology, various tissue systems can be incubated in Bioreactor is the core of biological processes. The biological systems include enzymes, microorganisms, animal cells, plant cells, and tissues. To design an appropriate bioreactor for a particular cell studies, such as cell growth, metabolism, genetic manipulation, and protein or other product expression, are needed to understand the cells requirement on their physical and chemical environment. It is also necessary to control and optimize the bioreactor environment *via* operating variables in order to favor the desired functions of the cells and achieve cost effective large-scale manufacture. In this article, fundamental design principles and various types of bioreactors including stirred tank, pneumatically agitated, membrane, fixed and fluidized bed, and wave bioreactors are reviewed. The effects of variables biological performances such as temperature, pH, mixing, oxygen transfer, and shear force, are discussed. Bioreactor operation strategies include continuous, semi continuous, and perfusion cultures. For the industrial application of bioreactors and bioprocess monitoring, modeling and simulation are also very important. Finally, we briefly summarize the trends in bioreactor technology including micro bioreactor cells as super bioreactors.

Organisms that grow in bioreactors can be soaked in liquid medium or attached to the surface of solid medium. Aquatic cultures can be suspended or immobilized. Suspension bioreactors can be used with a wide variety of organisms, as they do not require special mounting surfaces and can be operated on a much larger scale than immobilized cultures. However, in a continuously manipulated process, the organism is removed from the reactor along with the wastewater. Immobilization is a general term that describes different for the attachment or capture of cells or particles. It can be applied to virtually all types of biocatalysts, including enzymes, organelles, and animal and plant cells and organs. Immobilization is useful for continuously manipulated processes because the microorganisms are not removed by the reactor effluent, but the microorganisms are limited in scope because they are only present on the surface of the vessel.

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