AlgiMatrix™ 3D Culture System: a new user-friendly, animal origin-free bioscaffold for three-dimensional cell culture.

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AlgiMatrix™ 3D Culture System is a bioscaffold made of animal origin-free alginates, which are natural polysaccharides extracted from brown seaweed. Alginates have been widely used in the food, cosmetic and pharmaceutical industry for many years. The alginates in AlgiMatrix™ form porous sponges, which have 90% porosity and pores of 50-200 µm in size (fig. 1A). Cells grown in this alginate sponge form extensive three-dimensional structures, and grow as spheroids (fig. 1B, C). As a result of its alginate origin, AlgiMatrix™ 3D Culture System is completely animal-origin free, thus limiting potential bio-active elements and enhancing its potential in drug discovery.

Introduction

Animals are multi-cellular, three-dimensional organisms, yet most of our cell models rely on two-dimensional culture methods. A vast body of literature demonstrates that two-dimensional cell culture obscures the wild-type characteristics of many cell types (reviewed in ¹⁻³). Three-dimensional (3D) cell culture systems are commercially available, but hampered by several factors: they need very specific equipment, are difficult to work with, contain biologically-active contaminants, have animal-derived components, or involve procedures potentially harmful to cells. As a result, these systems have not fully penetrated the academic and industrial research world.

In this paper, we present AlgiMatrix™ 3D Culture System, a new three-dimensional cell culture system that eliminates these drawbacks. AlgiMatrix™ 3D Culture System provides the following four major advantages:

- Cells grow as spheroids which optimizes cell to cell contact; this creates a 3D cell culture model that better mimics normal cell behavior and morphology.
- Deliver more consistent results than animal-derived matrices
- Sterile plates with lyophilized AlgiMatrix™ are easy to use and stable at room temperature.
- Animal origin-free, formulated with pharmaceutical grade raw material.

An animal-origin free alginate sponge

AlgiMatrix™ 3D Culture System is a bioscaffold made of alginates, which are natural polysaccharides extracted from brown seaweed. Purified alginates have been widely used in the food, cosmetic and pharmaceutical industry for many years. The alginates in AlgiMatrix™ form porous sponges, which have 90% porosity and pores of 50-200 µm in size (fig. 1A). Cells grown in this alginate sponge form extensive three-dimensional structures, and grow as spheroids (fig. 1B, C). As a result of its alginate origin, AlgiMatrix™ 3D Culture System is completely animal-origin free, thus limiting potential bio-active elements and enhancing its potential in drug discovery.

Easy to use

AlgiMatrix™ 3D Culture System comes ready for use, lyophilized in sterile multwell tissue culture plates. Seeding the plates and growing the cells takes a few simple steps, using procedures common in regular 2D cell culture (fig. 1D). There is no need for specialized equipment, tricky and uncommon matrix formation steps, or procedures that are harmful to the cells.

Figure 1: AlgiMatrix™ 3D Culture System is an easy-to-use alginate sponge. A. AlgiMatrix™ 3D Culture System has a highly porous structure. B. Spheroid formation in AlgiMatrix™. C. Image of one cell spheroid grown in AlgiMatrix™. D. Workflow of seeding and growing cells in AlgiMatrix™. E. Overview of downstream assays after cells are grown in AlgiMatrix™.

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After suitable spheroids have formed, perform assays as desired. The AlgiMatrix™ 3D Culture System is very accommodating to your downstream assay. You can perform your assays directly on the live spheroids within the sponges, on the isolated spheroids, on the isolated cells, or you can embed the spheroids within the sponges with paraffin and use sections for staining (fig. 1E).

**Quantifiably better results**

AlgiMatrix™ 3D Culture System alginate sponges are very suitable for human Embryonic Stem Cell (hESC) culture. Compared to 2D cell culture, hESC embryoid bodies grow 2-fold faster in alginate sponges, which coincides with decreased necrosis in the central areas of the spheroids (fig. 2A). 4

The AlgiMatrix™ 3D Culture System also significantly enhances the metabolic activity of liver-derived cells. As shown in figure 2B, CYP1A2 activity increases 3- to 4-fold in human hepatocarcinoma HepG2-C3A cells grown in the AlgiMatrix™ 3D Culture System, compared to 2D cultures or competitor’s matrices.

**AlgiMatrix™ promotes normal cell behavior**

Cells cultured in alginate sponges act much more like their in vivo counterparts, as documented in Figure 3. Hepatocytes grown as spheroids in AlgiMatrix™ express high levels of the extra-cellular matrix protein laminin and the proliferation marker PCNA (fig. 3A, B). Cardiac cells form long fiber-like structures with α-actinin expression (fig. 3C), while endothelial cells form elongated shapes in response to vEGF (fig. 3D). Formation of embryoid bodies by human embryonic stem cells is much more controlled, without central necrosis, in stem cells grown in alginate sponge compared to petridishes (fig. 3E, F).
Summary of published applications

AlgiMatrix™ 3D Culture System is suitable for many three-dimensional cell studies and drug discovery applications. Below is a summary of published successful uses of alginate sponges.

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References


For more information, go to [www.invitrogen.com/3D-cellculture](http://www.invitrogen.com/3D-cellculture)