Seaweed Transformed Into Stem Cell Technology

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Engineers at Rensselaer Polytechnic Institute have transformed a polymer found in common brown seaweed into a device that can support the growth and release of stem cells at the sight of a bodily injury or at the source of a disease.

The findings, which are detailed in the December 2007 edition of *Biomaterials*, mark an important step in efforts to develop new medical therapies using stem cells.

“We have developed a scaffold for stem cell culture that can degrade in the body at a controlled rate,” said lead researcher Ravi Kane, professor of chemical and biological engineering. “With this level of control we can foster the growth of stem cells in the scaffold and direct how, when, and where we want them to be released in the body.”

Kane and his collaborators, which include the author of the paper and former Rensselaer graduate student Randolph Ashton, created the device from a material known as alginate. Alginate is a complex carbohydrate found naturally in brown seaweed. When mixed with calcium, alginate gels into a rigid, three-dimensional mesh.

The device could have wide-ranging potential for use in regenerative medicine, Kane explains. For example, the scaffolds could one day be used in the human body to release stem cells directly into injured tissue. Kane and his colleagues hope that the scaffold could eventually be used for medical therapies such as releasing healthy bone stem cells right at

the site of a broken bone, or releasing neural stem cells in the brain where cells have been killed by diseases such as Alzheimer's.

Kane and his team encapsulated healthy neural stem cells in the alginate mesh, producing a three-dimensional scaffold that degrades at a tunable, controlled rate. Once the scaffold is implanted in the body, the researchers use an enzyme called alginate lyase, which eats away at alginate, to release the stem cells. Alginate lyase is naturally produced in some marine animals and bacterial strains, but not in humans.

In order to control the degradation of the alginate scaffold, the researchers encapsulated varying amounts of alginate lyase into microscale beads, called microspheres. The microspheres containing the alginate lyase were then encapsulated into the larger alginate scaffolds along with the stem cells. As the microspheres degraded, the alginate lyase enzyme was released into the larger alginate scaffold and slowly began to eat away at its surface, releasing the healthy stem cells in a controlled fashion.

The microspheres also can be filled with more than just alginate lyase. "We can add drug molecules or proteins to the microspheres along with the alginate lyase that, when released into the larger alginate scaffold, could influence the fate of the encapsulated stem cells," Kane said. "By adding these materials to the larger scaffold, we can direct the stem cells to become the type of mature, differentiated cell that we desire, such as a neuron. This will prove very valuable for applications of stem cells in regenerative medicine."

Kane and Ashton were assisted in their research by Professor David V. Schaffer of the University of California at Berkeley; Akhilesh Banerjee, a Rensselaer graduate student; and Supriya Punyani, a Rensselaer postdoctoral associate.

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Source: Rensselaer Polytechnic Institute