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Extruded starch as novel shape-memory bioresorbable biomedical device

Anne Beilvert^a, Frédéric Chaubet^b, Laurent Chaunier^a, Didier Letourneur^b, Anne Meddahi-Pellé^b and Denis Lourdin^{a*}

^a INRA, UR 1268 Biopolymères Interactions et Assemblages, 44316 Nantes, France. Fax : +33 240 675 005; Tel : +33 240 675 147; E-mail : denis.lourdin@nantes.inra.fr,

^b LBPC, Institut Galilée, Université Paris 13, 93430 Villetaneuse, INSERM U698, F-75877 Paris, France. Fax: +33 140 258 602; Tel: 33 140 257 539.

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Starch is a wide-spread biopolymer which can be extruded as biomaterial presenting shape-memory properties. It can be manufactured into an easy implantable device that will recover its useful shape when it's above its glass transition temperature (T_g) which can be triggered at body temperature and moisture.

In preliminary studies, potato starch was extruded as a long wire (diameter 4.3 mm) with or without glycerol to modulate T_g and Young's modulus. Physical characterisations were performed after samples reached water equilibrium, about 13% wet basis, under constant relative humidity of 59% at 20°C. Samples were sterilised by gamma-rays irradiation. Adding 20% glycerol to starch decreased both T_g, from 77°C to 15°C, and Young's modulus of materials, from 1.1 GPa to 0.07 GPa. Physical properties of extruded starch and shape-memory were not strongly altered by gamma-rays sterilization unlike hydroxyapatite or poly-L-lactide biomaterials.

To evaluate acute inflammatory in vivo response, extruded wires were implanted in rats in an abdominal intramuscular position for 8 days. The histological examination of implants were performed and evidenced a fair degradation and the absence of acute inflammatory response. These preliminary results indicate that extruded shape-memory starch could be a novel material with bioresorbable abilities.