Starch materials for resorbable medical devices, application for a shape memory stent

Laurent Chaunier1, Diégo Vélasquez1, Anne Beilvert1, Anne Meddahi-Pellé2 and Denis Lourdin1

1INRA, UR1268, Unité Biopolymer Interactions and Assemblies, 44300 Nantes, France
2INSERM, U698, Bioengineering for Cardiovascular and Therapy Team, 75877 Paris, France
Corresponding author: denis.lourdin@inra.fr

ABSTRACT:
Starch-based materials have attracted significant interest for the development of innovative materials for biomedical applications1. Thanks to its thermoplastic behaviour, 3D objects can be fabricated by use of processes such as extrusion, thermomoulding or injection. Moreover, naturally extruded thermoplastic starch presents efficient shape memory properties, which can be triggered by body temperature or humidity2. It allows applications in outpatient surgery, thus minimizing the need for anesthesia and reducing hospitalization time. The structure, swelling and mechanical properties of starch-based materials from potato and amylose-rich maize starches, with and without plasticizer, have been studied on materials immersed in physiological conditions for a period of 30 days. It is shown that glycerol plasticization favours a fast crystallization of potato starch materials which enhances their mechanical strength and durability and a weak swelling3. Potato starch presented a good tissue integration and no significant inflammation or foreign body response after 30 days intra-muscular implantation in a rat model, contrary to amylose-rich maize starch materials. This allowed them to be used as a bioresorbable and biocompatible material for innovative implantable medical devices. Finally, the design and the evaluation of a shape memory starch-based stent for the treatment of a salivary duct disease will be presented. We propose an overview of these studies realised in our group since several years.


KEYWORDS:
starch; extrusion; shape memory; biomedical; implant;