Contribution ID: **415** Type: **Oral**

Radiation Modification of Carboxymethylated Chitosan –from Basics to Applications

Friday, 28 April 2017 11:35 (10 minutes)

The mainstream of radiation modifications of polysaccharides was limited to reduction of molecular weight due to main-chain degradation in order to facilitate further processing or induce specific biological activities. On the other hand, graft polymerization of functional monomers initiated through radicals crated by ionizing radiation on polysaccharide chains, or as effect of glycosidic bonds cleavage, was also extensively explored. Besides, possibility of crosslinking of polysaccharides by radiation initiation was demonstrated, firstly for water-soluble cellulose derivatives –high degree of substitution (DS) of cellulose with side chains and high concentration in aqueous solution were found to be advantageous to obtain significant yield of gel fraction. In the present investigations behavior of carboxymethylchitosan under ionizing radiation was explored and exemplary application proposed.

Carboxymethylchitosan (CMCS) of the deacetylation degree (DDA) 93.8%, DS 96% was obtained from Kraeber & Co. GmbH (Germany). Medical grade chitosan (CS) obtained from Heppe Medical Chitosan GmbH (Germany), with DS 90% was also used. Solutions of CMCS and CS were irradiated by electron beam (EB) with and without a crosslinking agent of poly(ethylene glycol) diacrylate (PEGDA, Sigma-Aldrich). Obtained gels were evaluated by standard sol-gel analysis.

Results of this study indicated that ionizing radiation is a convenient tool to synthetize hydrogels based on CMCS either with or without PEGDA when irradiated in highly concentrated solutions, whereas CS, its parent polysaccharide, as expected, is prone to form gels only in the presence of the crosslinking agent. The method engaging PEGDA allows formation of macroscopic gels even from a CMCS and CS solutions of low concentration resulting in gels of gel fraction as high as 80%, which is distinct from the known technique of polysaccharide crosslinking in the paste-like state –irradiation of CMCS 20% concentration results in gel fraction less than 50%. The CMCS gels were found no to cause cytotoxicity (as tested by LDH assay) and demonstrated antimicrobial activity, especially towards gram negative bacteria.
If the dose applied for gel formation is of 25 kGy or more, it may be sterilized simultaneously during its synthesis. This was explored (CMCS aqueous solution) in manufacturing of internal hydrogel scaffold for nerve regeneration guides. Regular nerve guidance tubes of polylactide & polycarbonate, elaborated in our laboratory, were filled with CMCS mixture with water –paste like-state or physical gel, based on conditions determined in this study –and irradiated with EB. After in situ synthesis of the gel inside the tube, the product is ready for immediate use, because applied technology combines gel formation and sterilization into a single process.

Country/Organization invited to participate

Poland

Primary author: Mr WACH, Radoslaw (Institute of Applied Radiation Chemistry, Lodz University of Technology, Poland)

Co-authors: Mr ROSIAK, Janusz (Institute of Applied Radiation Chemistry, Lodz University of Technology, Poland); Mr ULANSKI, Piotr (Institute of Applied Radiation Chemistry, Lodz University of Technology, Poland)

Presenter: Mr WACH, Radoslaw (Institute of Applied Radiation Chemistry, Lodz University of Technology, Poland)

Session Classification: A15

Track Classification: RADIATION SYNTHESIS AND MODIFICATION OF MATERIALS