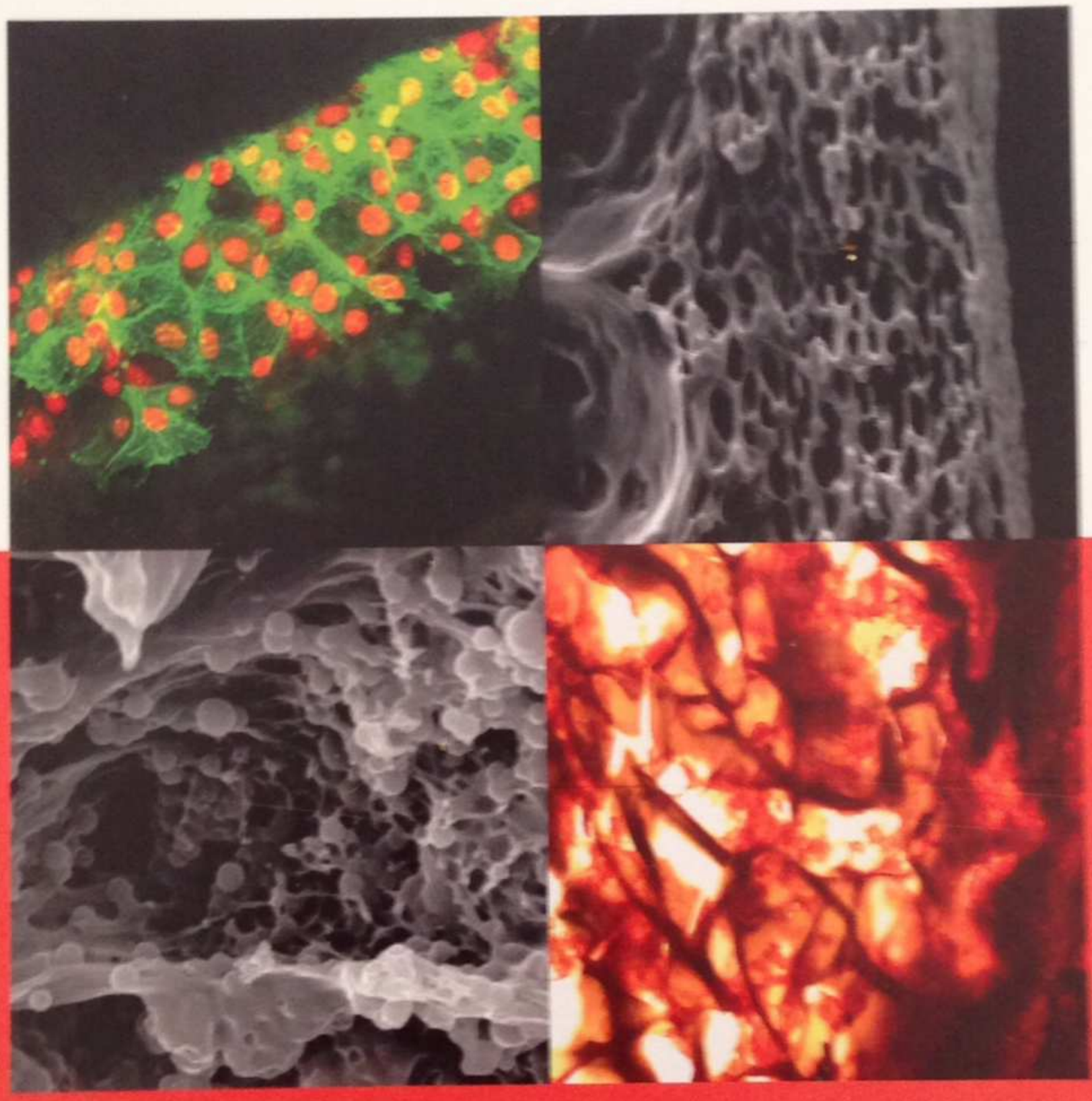
I MATERIALI BIOCOMPATIBILI PER LA MEDICINA

Convegno Nazionale della Società Italiana Biomateriali
Palermo, 2-4 luglio 2014



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TEMPERATURE-TRIGGERED MACROSCOPIC GELATION OF IRRADIATED XYLOGLUCANS FOR BIOMEDICAL APPLICATIONS

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Introduction

Native xyloglucans are film forming polymers that can also undergo gelation under various conditions: i.e. by addition of moderate amount of alcohols, polyphenols and iodine solutions. When xyloglucan is partially degraded by fungal β-galactosidase to remove more than 35% of the galactose residues, it exhibits a thermally reversible transition from sol to gel in aqueous solutions at concentration above 1-2 wt% (Shirakawa et al., 1998). Owing to their natural source, xyloglucans show high average molecular weight, broad molecular weight distribution and poor water solubility, as large and compact aggregates usually form via inter-molecular hydrogen bonding. The present investigation is aimed to assess whether gamma-irradiation induces significant chemical modification on the biopolymer and influences the mechanical and morphological properties of the macroscopic gels. This study was carried out by dynamic-mechanical stress rheometry and scanning electron microscopy. Results provide insights into the potential of high-energy radiation processing as a tool to tailor the molecular properties of these biopolymers in order to obtain bio-resorbable scaffolds for regenerative medicine and/or drug delivery depots.

Materials and Methods

Irradiation conditions and sample preparation

Xyloglucan with a galactose removal ratio of 44% (Deg-XG) was kindly provided by DSP Gokyo, Food and Chemical Co, Japan. Deg-XG powder was g-irradiated in air at room temperature using a ^{60}Co source (Gamma Chamber 5000, Institute of Nuclear Chemistry and Technology, Warsaw, Poland) at 8 kGy/h and irradiation doses of 10, 20, 40 and 60 kGy. Samples of irradiated Deg-XG were prepared according to an established procedure. (Todaro et al., 2014). Macroscopic thermo-reversible gels were obtained by conditioning the polymer dispersions at 37°C for 5 minutes.

Characterization methods

The effect of the irradiation dose in the low concentration samples was studied by gel filtration chromatography, dynamic light scattering and shear viscosity measurements. FT-IR measurements were performed to evaluate the presence of chemical modifications in the irradiated samples.
Morphology and mechanical properties of macrogels prepared from the irradiated polymer were studied by scanning electron microscopy and dynamic-mechanical stress rheometry, respectively.

Results and Discussion

Gamma-irradiation can be used as a tool to manipulate the molecular weight distribution of polyglucans, thus affecting their physico-chemical properties and self-assembly behavior.
In the case of xyloglucan, a progressive decrease of the average molecular weight is observed at the increase of the irradiation dose (Todaro et al., 2014). No significant chemical modifications of functional groups are observed upon gamma irradiation of the polymer, as shown by FTIR studies.
The average hydrodynamic diameter, determined by dynamic light scattering measurements performed on Deg-XG dispersions in the semi-dilute regime (0.1 wt% polymer concentration) did not significantly vary with the irradiation dose.
The study of Deg-XG gels mechanical properties at the variance of the irradiation dose and/or polymer concentration in water shows how it is possible to enhance and/or tailor gels' mechanical properties by

manipulating these parameters, suggesting a promising versatility of these systems for biomedical ap
plications. Indeed, incorporation and release of bioactive molecules and the interaction between Deg
XG systems and cells are under evaluation.

Acknowledgements

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References

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