Università degli Studi di Napoli Federico II

PhD in Biotechnology - 36th cycle

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"Poly-γ -glutamic acid-based bioplastics"

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The answer to be given to the environmental pollution due to plastic polymers is a pressing challenge to the disposal of plastic waste that affects marine, air and soil ecosystem (Porta, 2019). Over than 5 trillion plastic particles weighing about 300 thousand tons float on the surface of oceans releasing numerous toxic compounds. These micro- and nano-plastics are considered as life threating, as it has been reported that more than 100,000 mammals, as well as millions of birds and fish, are annually killed (about one million and half of plastic residues were found in the digestive system of albatrosses in the Midway Island).

Renewable material sources might provide solutions for manufacturers to control pollution, manage waste and maintain the sustainability of the production of the needed materials. Renewable packaging industry has become, thus, an urging area for research and development. Recently, "bio-plastics" have been demonstrated as one of the most innovative materials.

Among the possible biodegradable/edible polymers, poly-γ-glutamic acid (PGA) is a naturally occurring polyamide synthesized by a variety of *Bacillus* species and composed by glutamic acid monomers linked by amide bonds between α-amino and γ-carboxyl groups. This anionic homopolypeptide is an optically active biopolymer having a chiral centre in every glutamate unit (Najar & Das, 2015). Little is known on the ability of polypeptides constituted by the same amino acid to give rise to materials with plastic-like properties. Tong et al. (2017) have studied the effect of the blending of sodium alginate with PGA composite microparticles. Thus, alginate/PGA composite microparticles with controllable structure were successfully prepared through the emulsification/internal gelation method and their characterization demonstrated that alginate/PGA composite microparticles possess

good biocompatibility and are promising candidates for applications in medical field. In addition, recent studies showed that ultrafiltration methods provide different molecular species of PGA biologically synthesized, potentially able to give rise to a biodegradable material possessing different mechanical properties (Sabbah et al., 2020). Therefore, PGA-based bioplastic is a promising candidate to produce films endowed with properties similar to those of the traditional plastic-materials.

The aim of the present project is to optimize and reinforce homopolypeptide-based bioplastics for tailored food and plant coatings to be applied in packaging systems and/or agriculture sectors. The most relevant attempts to produce these innovative bio-plastics concern to study the film forming solution formulation and the film preparation conditions, including plasticization, pH change, nanoparticle addition, as well as possible chemical or enzymatic cross-linking. PGA blending with polysaccharides is also an important strategy to try to improve the mechanical and permeability properties of the final new material.

References

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