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Editorial

Chitosan Membranes for Sustainable Packaging

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Food packaging is the ambassador in the search of materials with improved barrier permeation properties to O_2, CO_2, water and aroma vapours, responsible of degradation of perishable products' shelf-life, together with increasing functionalities such as antimicrobial, transparency, prevention and control of pollutants, biodegradability, to make the active intelligent packaging of the future. The *urgency of developing bio-based environmentally friendly economic materials with improved barrier properties*, transparent, biodegradable, thermal, mechanical and moisture resistance, another intelligent features [1] leads the research focus biopolymers and nanotechnology. In particular, chitosan is continuous object of research in food packaging [2,3] due to its biodegradable, non-toxic, transparent, hydrophilic and antimicrobial character, together with a cation ion exchange capacity of 0.57meq/g [4]. The high hydrophilicity limits the mechanical strength. This hydrophilicity can be correlated to the degree of deacetylation of chitosan [5]. The density and crystallinity of the chitosan polymer is related to the functional properties of the films [6]. The control of hydrophilicity helps controlling the degradation rate of the material, which is of paramount importance in the present research effort of biomass based and environmentally friendly polymers [5]. Thus, it is usual to mix chitosan polymer with cellulose fibers [7], blends with other polymers such as PVA or PVP [8] or cellulose acetate where chitosan provides the functional groups to open up the potential for pervaporation separation, metal [9] and toxic pollutants removal from waste waters [10]. Chitosan also shows potential as sustainable packaging material in comparison with the environmental impacts of conventional systems [11].

Most unique properties of chitosan derive from the ion exchange capacity of this biopolymer, achieved by derivatization of the amino and hydroxyl groups, either for tuning the flux and selectivity in the pervaporation separation of organic-water mixtures [12] or mucoadhesive applications in pharmaceutical industry [13]. The addition of plasticizers is usually needed to improve flexibility in dry state. The use of PEG-plasticizers in chitosan films for pharmaceutical applications has been recently reviewed [14]. PEG reduced the toxicity of the films but increases membrane permeation, thus the use as barrier films is limited, although it opens up the field to other membrane separations. The main challenge of mixed matrix or composite membranes is the compatibility between the components, and this has been attempted in nanocomposite technology by attempting the similarity of composition using carbon nanotubes [15], graphene oxide [16] as fillers of chitosan-based matrices, or similar hydrophilicity [17] or compatible ion exchange capacity [18,19] to improve the mechanical and thermal properties of chitosan biopolymer without costly or toxic organic plasticizers or additives. This could improve the sustainability of the production of novel plastic packaging [20], in agreement with the consumers demand on ecological transparency [21].

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