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Radiation Mediated Bioactive Compounds Immobilization on Polymers to Obtain Multifunctional Food Packaging Materials

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Background: Irradiation of polymeric surface is a versatile way to implement specific functionalities which further can react with bioactive compounds in order to confer to materials antimicrobial, antioxidant and biological functions absolutely necessary to protect, prolong self life of food products and make them beneficial for health.
Methodology: Both undegradable and degradable polymers were exposed in optima conditions to gamma-rays or cold plasma in various atmospheres (air, oxygen, nitrogen) and oxygen and nitrogen - containing groups were reacted with chitosan, vitamin E and C and vegetable oils with high therapeutic value encapsulated in nanostructures obtained by co-axial electrospinning or emulsion techniques. The nanoencapsulation of active (antimicrobial and antioxidant) vegetable oils into chitosan matrix by leads to a significant decrease of Total Viable Counts when compared with the PLA substrate plasma pre-treated and surface modified only with chitosan.Bioactive layer was covalently linked onto polymeric substrate so it is stable, compounds do not migrate in food products and bulk properties of base materials are not changed.
Results: Bioactive multifunctional polyethylene based food packaging with antimicrobial activity against both gram positive and gram negative bacteria and antioxidant activities have been obtained. Use of chitosan/vegetable oils shows synergistic activities. Other two biodegradable substrates as polylactic acid and cellulosic materials (cellulose/chitin blends and kraft papers) were undergone to the same procedures with very promising results moreover these are easily recyclable and integrate into environment after use. Assessment of degradation of materials was investigated by enzymatic degradation in presence of Phanerochaete chrysosporium by biochemical investigation (superoxide dismutase activity in fungi mycelium samples, content of malondialdehyde, catalase enzyme, extracellular protein), changes in average molecular weight, ATR-FTIR and AFM. The plasma and gamma radiation exposed PLA and PLA/CHT stratified composites supported fungal growth resulting in their degradation, which is reflected in change in polymeric substrate structure. The presence of bioaccessible material, i.e., PLA and chitosan, facilitated degradation. The plasma and gamma irradiated PLA samples show increased degradation. Natural and synthetic polymeric substrates, plasma activated and /or gamma-irradiated,were tested as active-food packaging to improve the shelf-life of the poultry meat, fresh beef meet, fresh curd cheese and apple juice. Rosehip seeds oil was found to impart the best antioxidant and antimicrobial properties.
Conclusion: By comparison of gamma-rays or cold plasma exposure it can conclude that gamma-irradiation is more efficient in terms of bioactive functions of obtained materials.

Country/Organization invited to participate

Romania

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