Antibacterial activity and transport properties of polyethylene films loaded with nanoemulsions of plant extracts for food packaging applications

Context

At the present time, most packaging materials are thermoplastics based on olefin polymers, for example, polyethylene (PE) and polypropylene (PP). They tend to be superior to other types of materials because of their low cost, light weight, high corrosion resistance and recyclability. However, one of their major drawbacks in food packaging is their lack of antimicrobial property. There had been many attempts to improve this property by the addition of various antimicrobial agents such as organic acids, inorganic gases, bacteriocins, silver metals, and others. Nevertheless, the use of synthetic materials or chemicals as the antimicrobial agents in food packaging has raised consumer concerns as well as environmental issues. Natural plant extracts are a safe alternative to improve antimicrobial properties in food packaging such as PE or PP films instead of using synthetic chemicals.

The incorporation of these natural antimicrobial agents into polymer-based packaging comes with certain challenges related to the active molecules' sensitivity to temperature, dioxygen, light, and pH, their volatility, chemical instability and their dispersion in the high viscosity polymer matrix. An approach to overcome such challenges is the use of encapsulation, and in this context one of the most promising approaches is the formulation of antimicrobials containing micro/nanoemulsions. This encapsulation will preserve and enhance the functional properties of these antimicrobial agents prior to their incorporation into the polymeric packaging film.

The main objective of this work is to formulate antimicrobial micro/nanoemulsions and incorporate them into polymer matrices using melt processing technique to inhibit or retard the growth of microorganisms, thereby reducing food losses along the production and supply chains and increasing food safety and prolonging shelf-life. The influence of the presence of the antimicrobial agents on the thermal, microstructural, mechanical and barrier properties will be investigated.

The internship will take place in the Laboratoire Ingénierie des Matériaux Polymères, UMR5223 (IMP) and Laboratoire d'Automatique, de Génie des Procédés et de Génie Pharmaceutique, UMR 5007 (LAGEPP).

IMP is a joint research unit between the CNRS and Université de Lyon1. Its research activities range from the tailored synthesis of macromolecular architectures and polymer processing to the elaboration of complex materials and establishment of structure- properties relationships. The IMP gathers together complementary skills: synthesis, structural characterization and physico-chemical properties, in the fields of polymers and materials science.

LAGEPP is a joint research unit between the CNRS and Université de Lyon1. It's a multidisciplinary laboratory covering the fields of process engineering, automation, product engineering, pharmaceutical engineering and physical chemistry. The LAGEPP is focusing on two main scientific themes: (i) Physicochemical processes in complex, dispersed and evolving media (nanoparticle production processes, crystallization, freeze-drying) and (ii) dynamic modeling, observation and control of processes.

Profile

The candidate should have a good knowledge of the physico-chemistry of polymers and a strong interest in experiments and polymer characterization techniques. The candidate looks forward to working in a collaborative, multicultural, and open-minded team and must show enthusiasm, initiative and autonomy.

Application material: cover letter, CV in French or English
Application deadline: December 31th, 2023
Starting date: February 1st, 2024 (very earliest) to March 31th, 2024 (very latest)
Contract duration: 6 months
Salary: around 800 €/month
Please send your complete application material with subject "Master Position Application IMP-LAGEPP" to:
Dr. Fabrice GOUANVE (fabrice.gouanve@univ-lyon1.fr) and Dr. GHNIMI SAMI (sami.ghnimi@univ-lyon1.fr).