ANTIMICROBIAN THERMOPLASTIC NANOCOMPOSITE MATERIALS WITH POTENTIAL APPLICATIONS IN AGRICULTURE AND FOOD INDUSTRIES

SUMMARY

Nowadays there has been a growing increase in the use of plastics in the world of agriculture and food industry, among others, in the form of films for greenhouses and containers or thin films for packaging. Obviously, in all these uses there is a need not only that they are easily processable materials to lower their manufacture cost, but also to present good properties (mechanical, optical, as well as good appearance to the consumer). Regarding the use of plastics for greenhouses, apart from protecting crops againts the action of non-desired radiations many times to minimize the growth of microorganisms is convenient. On the other hand, for food packaging the deterioration of food can come from the growth of bacteria on the material surface. For all these reasons, it is necessary to design new materials with the most appropriate performance for this kind of applications, namely: i) easily processable; ii) with appropriate mechanical and physicochemical properties; iii) able to absorb ultraviolet radiation; iv) with antimicrobian effect and v) able to release active agents in a controlled way. A possible answer to these requirements could be the introduction in thermoplastic polymers of nanoparticles with highly specific properties. Although the nanoparticles use is almost null in the food industry since there is not any clear regulation yet in terms of their toxicity, research should not be restricted. The idea is to introduce modified or un-modified nanoparticles within thermoplastic polymers capable of improving general properties of those polymers (mechanical and degradation) and to confer new features such as having a bactericidal effect or to release active agents in a controlled manner. Schematically the project can be presented as follows: i) selection of nanoparticles with potential bactericidal effect (Cu, Ag and TiO2); ii) modification and characterization of nanoparticles with cyclodextrins (CDs), poloxamers (Pluronics) or poloxamines (Tetronics); iii) preparation of supramolecular structures obtaining inclusion complex cyclodextrines/ active agents (antibiotics and or preservatives) or specific associations between Pluronics or Tetronics with active agents; iv) Characterization of the modified nanoparticles; v) preparation of nanocomposites: formed by a thermoplastic matrix filled with the nanoparticles; vi) characterization of the nanocomposite materials, and vii) behavior of the new materials under serving-conditions (aging, bacterial proliferation and controlled release of bioactive compounds). Special attention will be paid to the study of controlled release studies either at macroscale and nanoscale (by the novel use fluorescece probes and labels). Besides, it will be tried to understand the causes by which the presence of nanoparticles at times exerts intrinsic antibacterial effect (modification of surface-associated adhesion of new materials, direct action of nanoparticles on bacterial metabolism) since this is something confusing and would allow disigning more effectively the materials under consideration. Among others, and as an original study, it is proposed the use of atomic force microscopy (AFM) to track the deterioration of the bacterial cell wall from indentation measurements and the analysis of its mechanical properties.

KEW WORDS: Nanocomposite materials; Supramolecular systems, Bactericidal effect; Controlled release; Fluorescence; AFM.