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Main Objective: The use of ionizing radiation and plasma gas discharge for developing new surface active polymeric materials with special properties for food packaging application.

The specific objectives of the project are classified in two major directions:
I) the activation of polymeric materials using ionizing radiation and plasma gas discharge technologies. By application of these surface activation/functionlization techniques the bulk properties of polymers are maintained.
II) the functionalization with active/bioactive compounds by several coating/immobilization procedures.

(1): The surface activated synthetic polymers namely polyolefins (PO) and poly (lactic acid) (PLA), will be further coated with active/bioactive compounds like chitosan, lactoferrin, vitamin E, vitamin C and beta carotene, individually or mixed together.

(2): Surface activated cellulose-based materials will be grafted with different phenolic compounds (p-hydroxybenzoic acid, caffeic acid, gallic acid, eugenol and thymol) and vegetable oils by impregnation and/or coupling reaction.
Achievements

✓ New surface functionalized materials have been obtained by covalent binding of some bioactive components (chitosan and vitamin E and C and various vegetable oils) by a two step procedure: I) cold plasma or ionizing radiation activation II) carbodiimide coupling reaction (EDC+NHS) onto PE, PLA and cellulosic surface: two biodegradable and one non-biodegradable substrate were chosen.

✓ For all modified substrates by plasma activation or gamma irradiation the following orders were established:

- **Poly(lactic acid) (PLA) packaging material** antioxidant activity: PLA/cp N₂/EDC+NHS/LF < PLA/cp N₂/EDC+NHS/CHT < PLA/20kGy/EDC+NHS/LF << PLA/20kGy/EDC+NHS/CHT, while in respect with antibacterial activity: PLA/cp N₂/EDC+NHS/LF < PLA/20kGy/EDC+NHS/LF ≈ PLA/20kGy/EDC+NHS/CHT ≈ PLA/cp N₂/EDC+NHS/CHT.

- **Cellulose (CC) packaging materials**, in case of plasma activation the following order of the antimicrobial properties was established: CC/cp air/RO > CC/20kGy/GO > CC/cp air/Eu > CC/20kGy/RO > CC/20kGy/Eu > CC/cp air/GO.

- **Polyethylene (PE) packaging material** antioxidant activity: PE/20kGy/EDC+NHS/CHT < PE/30kGy/EDC+NHS/RO < PE/cp air/EDC+NHS/CHT ≈ PE/20kGy/EDC+NHS/TT and for antibacterial character: PE/20kGy/EDC+NHS/TT < PE/30kGy/EDC+NHS/RO ≈ PE/20kGy/EDC+NHS/CHT ≈ PE/cp air/EDC+NHS/CHT.
Dissemination

Related Projects:

1. **Antimicrobial bionanocomposites for medical applications (BIONANOMED)**  
   Contract nr. 164/2012, PNII-PT-PCCA-Tip II UEFISCDI C. Vasile, project director;

2. **Bilateral collaboration Romania-Norway “Improving food safety through the development and implementation of active and biodegradable food packaging systems”**  

3. **Erasmus+: Joint innovative training and teaching/learning program in enhancing development and transfer knowledge of application of ionizing**  
   **TL-IRMP – coordinator Poland**, Romanian partner coordinator - C. Vasile.

Patents Applications

1. **Procedure and composition for obtaining new polymeric biocompatible bionanocomposites with antimicrobial and antioxidant properties for medical uses.**  
   R.N. Darie, R. Lipsa, N. Tudorachi, E. Paslaru, C. Vasile, B.S. Munteanu, OSIM A00598/ August 2014;

2. **Procedure and composition for obtaining bioactive (biocompatible and antimicrobial) polyurethane surfaces by electrospinning/electrospraying for medical and pharmaceutical uses.**  
Dissemination

Published papers:


Book chapters:


Communications and posters at international conferences:


