



BIOMICROPLASTIC RELEASE FROM POLYLACTIC ACID FOOD PACKAGING UNDER SIMULATED STRESS CONDITIONS: PRELIMINARY RESULTS

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The increasing use of biodegradable polymers in food packaging has raised concerns about their potential to contribute to the microplastic contamination of food. Due to its environmental sustainability features, Polylactic acid (PLA) biopolymer is widely regarded as a sustainable alternative to petroleum-based plastics for food packaging. It is classified as generally recognised as safe (GRAS) for certain food contact and packaging applications. However, under realistic food contact conditions, its behaviour as a potential source of biomicroplastics remains poorly characterised, particularly for fishery products.

This study investigated the release and transfer of PLA biomicroplastics from food-contact packaging containers into food simulants under stress conditions commonly encountered during production, storage, and transportation. In addition, Estimated Daily Intake (EDI) was calculated.

According to Annex III of EU Regulation 10/2011, simulant A (10% ethanol) and simulant D2 (olive oil) were selected for fishery products to represent aqueous and fatty food matrices, respectively. PLA-based containers were placed in contact with each simulant and subjected to freeze-thaw cycles, UVA-UVB irradiation, elevated temperature, and mechanical stress. For each treatment, three replicate containers were used, each in contact with 0.5 L of food simulant, for a total volume of 1.5 L of simulant per treatment. The PLA MPs were isolated by vacuum filtration, identified and quantified using micro-FTIR analysis. To assess potential human exposure to PLA, EDI was calculated for different age groups, as recommended by the European Food Safety Authority (EFSA).

A total of 36 PLA particles were detected in the food simulants. The highest particle release (41.67%) occurred under mechanical stress, and the lowest release (11.11%) was observed in freeze-thaw treatment.

In olive oil, a higher percentage of PLA MPs (55.56%) than in 10% ethanol (44.44%) was detected, suggesting that lipid content may influence bioparticle transfer and retention in food.

Mechanical abrasion appears to be the dominant mechanism driving particle release, which is consistent with recent EFSA conclusions on microplastic release from food-contact materials. Thermal and photo-oxidative irradiation may primarily act as facilitating factors, enhancing the PLA susceptibility to subsequent fragmentation in food. These preliminary results suggest that PLA packaging can be a measurable source of microplastic contamination under conditions that simulate real food contact, despite its biodegradability. The EDI calculation on food simulants, expressed either as the mass ingested per unit body weight per day ($\mu\text{g/kg BW/day}$), or as the number of particles ingested per unit body weight per day (PLA MP items/kg BW/day) indicated the highest exposure levels in infants ($16.53 \mu\text{g/kg BW/day}$ or $0.03 \text{ MP items/kg BW/day}$) and the lowest in the very elderly ($3.30 \mu\text{g/kg BW/day}$ and $0.006 \text{ MP items/kg BW/day}$).

These preliminary results highlight the need for further research into the long-term fate, bioavailability and toxicological effects of PLA MNPs under realistic food packaging conditions, and emphasise the importance of considering biodegradable polymers within the broader framework of food contact material safety assessment.