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Abstract

Assessment of Reprocessed Polylactic Acid from Controlled Virgin Feedstock for Food Packaging Applications †

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† Presented at the 3rd International Online Conference on Polymer Science, 19–21 November 2025; Available online: https://sciforum.net/event/IOCPS2025.

Keywords: PLA; reprocessed PLA; migration; VOCs; food packaging

The growing impact of fossil-based plastics on the environment has driven interest in bioplastics such as polylactic acid (PLA), a biobased and compostable polyester widely used in food packaging but with limited properties. Although designed for composting, preventing the contamination of traditional recycling streams is essential [1]. In industrial production, defective parts and burrs discarded can be reprocessed into pellets from a controlled source, avoiding complex washing [2]. Studies have evaluated performance after reprocessing cycles [3]. However, for food contact applications, the potential migration of substances, including non-intentionally added substances, remains a challenge [4].

This study evaluates the reuse of industrial discarded PLA parts for food contact. Films were produced from virgin and reprocessed PLA through melt extrusion followed by hot pressing, with reprocessing simulated by one additional extrusion cycle to the virgin material. Melt flow index (MFI), tensile test, overall migration (ethanol 50% v/v, 10 days, 40 °C), and water vapor transmission rate (WVTR) were assessed. Volatile compounds (VOCs), semi-volatile compounds (SVOCs), and non-volatile (NVOCs) compounds were identified through chromatographic/mass-spectrometric techniques. The migration of metals (Ba, Co, Mn, Zn, Cu, Fe, Li, Al, Ni, Eu, Gd, La, Tb, As, Cd, Cr, Pb, Hg, Sb) was tested in 3% acetic acid (60 °C, 10 days).

Results showed a slight rise in MFI, indicating minimal degradation [4]. Tensile strength and Young modulus decreased slightly but not significantly. WVTR remained comparable. Overall and metal migration increased marginally but stayed well below the legal limits [4]. The reprocessed PLA exhibited more VOCs and NVOCs absent in the virgin PLA sample. Aldehydes and oligomers predominated, though most showed low migration, underscoring the importance of clean equipment. Metal migration stayed below specific limits [4]. Overall, the reprocessed PLA retained functional properties and kept the migration of key substances within established limits.

Author Contributions: Conceptualization, M.P.A.; methodology, J.S.-C., S.F., M.S.R. and M.P.A.; software, J.S.-C., S.F., M.S.R. and M.P.A.; validation, J.S.-C., S.F., M.S.R. and M.P.A.; formal analysis, J.S.-C., S.F., M.S.R. and M.P.A.; investigation, J.S.-C., S.F., M.S.R. and M.P.A.; resources, M.P.A.; data curation, J.S.-C., S.F. and M.P.A.; writing—original draft preparation, J.S.-C., S.F., M.S.R. and M.P.A.; writing—review and editing, J.S.-C. and M.P.A.; visualization, J.S.-C., S.F., M.S.R. and M.P.A.;

Check for updates

Academic Editor: Valentina Siracusa

Published: 14 November 2025

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supervision, M.P.A.; project administration, M.P.A.; funding acquisition, M.P.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research is part of the PID-AEI project (grant PID2024-157368NB-C32) funded by MICIU/AEI/10.13039/501100011033 and by the "ERDF A way of making Europe" as well as the research consolidation project (grant CNS2022-136064) and TED-AEI project (grant TED2021-129920A-C43), funded by MCIN/AEI/10.13039/501100011033 and by the "European Union NextGenerationEU/PRTR". J. Sepúlveda acknowledges the "SDGine for Healthy People and Cities" project from the Universidad Politécnica de Madrid, funded by the European Union's Horizon 2020 Research and Innovation Programme under the Marie Skłodowska-Curie grant agreement No. 945139 and co-financed by ECOEMBALAJES ESPAÑA, S.A. (Ecoembes). S. Faba acknowledges the National Commission for Scientific and Technological Research (ANID, Chile) for their financial support (Postdoctoral Fellowship abroad, grant number 74230053).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The original contributions presented in this study can be obtained from the corresponding authors.

Conflicts of Interest: Author Marcos Sanchez-Rodriguez was employed by ECOEMBES ENTIDAD ADMINISTRADORA SLU. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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