Volatile Compounds and Off-odors Analysis of PLA from Recycling Cycle for Biodegradable Packaging Applications: An Essential Factor for Ensuring Food Safety and Quality

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Abstract

Recent European guidelines support the use of recycled and biodegradable packaging for food applications that involve single-use materials. In this work, PLA pellets were submitted to post-consumer recycling cycle industry. HS-SPME-GC-MS and HS-SPME-GC-O-MS methods have been used to detect hazardous volatile compounds and off-ofors profiles.

Introduction

Biodegradable and renewable plastics represent a new alternative that can reduce the environmental impact of using plastics from non-renewable sources (Ahmed et al. 2018). In addition, new European Commission guidelines intend to ban the production of single-use plastic packaging from non-renewable resources in favor of biodegradable bioplastics and, minimize the environmental impact of improper disposal of this type of packaging (Frans, Jyrki 2019; Commission, Sheet 2018). Therefore, an alternative that complies with the new guidelines is the recycling of bioplastics, which reduces the environmental impact, increases the added value of the material, and reintroduces it into the circular economy.

Aims

The objective of this study was to identify the odorsous compounds that can interfere with the aromatic profile of the PLA pellets that were submitted to the recycling cycle.

Method

Figure 1 illustrates the flowchart of PLA biopolymer recycling steps followed by HS-SPME-GC-MS and HS-SPME-GC-O-MS análisis. Table 1 presents the employed nomenclature for the steps that the samples were submitted.

Results

In this study, 34 different volatile and semi-volatile compounds including IAS and NIAS, have been identified in the PLA pellets submitted to post-consumer contamination procedure, washing and mechanical recycling. Furthermore, Figure 2 shows the relationship between the formation of different NIAS compounds with the steps of the PLA recycling process.

The radar graph shown in Figure 3 elucidates the impact of the aroma compounds classified and separate into 7 odor groups.

Conclusion

Most of the substances detected in the analysis were the result of the biopolymer chain breaking down, such as lear or branched alkanes and alkenes. The primary NIAS found in all samples and IAS have been formed during the mechanical recycling process. The presence of off-odors can indicate the formation of harmful compounds, which can affect the sensory properties of the food, and even compromise it. Therefore, it is crucial to take appropriate measures to prevent the formation of NIAS or remove them from the recycled PLA material.

Bibliography

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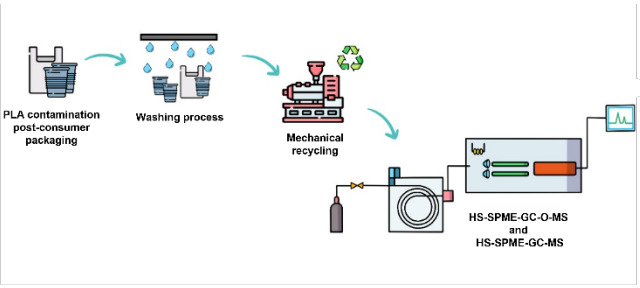

Figure 1: flowchart of the PLA biopolymer recycling process.

Figure 2: Schematic of the relationship between recycling process steps and the NIAS formation

Table 1: Nomenclature of the PLA samples.

Sample No	Samples description	Nomenclature #
1	PLA commercially	PLAp
2	PLA contaminated	PLAc
3	PLA commercially washed	PLApw
4	PLA commercially recycled	PLApr
5	PLA contaminated washed	PLAcw
6	PLA contaminated washed and recycled	PLAcwr
7	PLA contaminated recycled	PLAcr

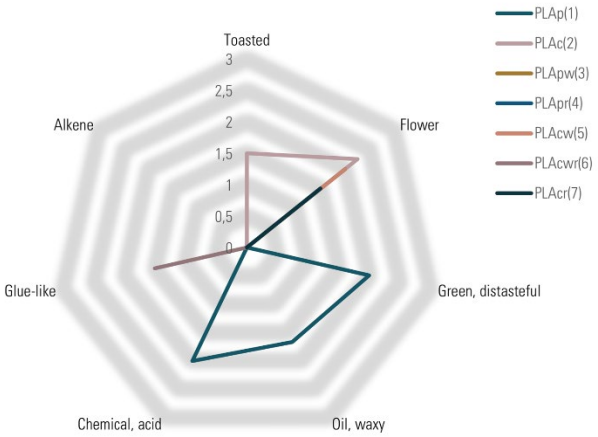

Figure 3: Results of the odor profile of the different PLA biopolymer samples represented by the radar graph comparing the odor intensity described by the panellists and catalogue in different odoriferous groups.