Screening of Volatile Organic Compounds Emitted from Different Packaging Materials: Case Study on Fresh-Cut Artichokes

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ABSTRACT

Keywords: Food packaging, Gas-chromatography-mass spectrometry, PA/PLA/PP, Potential migrants, Volatile organic compounds

INTRODUCTION

Artichoke is a rich source of bioactive phenolic compounds, and also inulin, fibres and minerals. The percentage of discarded portion, together with complex and time-consuming trimming process make artichoke processing as a fresh cut product very convenient. But fresh cut is more susceptible to oxidative and non-enzymatic reaction which lead to quality degradation and shelf-life reduction. So, in this case packaging is mandatory to prolong the shelf life of artichoke. Food packaging plays a very important role in the protection of food and the preservation of its taste and quality, and provides consumers with ingredient and nutritional information. However, packaging materials are not fully inert, and mass transfer occurs (volatile and non-volatile compounds) between packaging materials and foodstuffs, leading to potential safety and quality issues.

OBJECTIVE

The aim of work was to study the effect of modified atmosphere packaging condition on the emission of volatile organic compounds from commercially available plastic material in order to optimize more sustainable packaging

METHODOLOGY

In the present work, the emission of volatile organic compounds (VOCs) from plastic packages in contact with food and their presence in/on food was investigated. Based on previous results on fresh-cut artichokes as case study, micro perforated polypropylene (PP), polypropylene/polyamide (PP/PA) and polylactic acid (PLA) were selected as package materials. MA-packaged fresh-cut artichokes were stored for 6 days at 5° C. For the detection of VOCs on the plastic materials, two approaches were considered. First, a 2.5x2.5 cm package squared piece was cut, inserted into a SPME vial and conditioned at 30°C for 10 min. VOCs emitted from the package were then extracted by a DVB/CAR/PDMS solid phase micro extraction (SPME) fibre for 20 min, at 30°C, and analysed by gas-chromatography coupled to mass spectrometry (GC-MS). An empty vial was used as control. Second, a DVB/CAR/PDMS SPME fibre was used to extract volatile compounds for 30 min, at 5°C, from the whole bag headspace, to understand if any package volatile compound was transferred into the package atmosphere in this temperature condition. Finally, artichokes were also analysed by SPME/GC-MS to detect any presence of package volatiles.

RESULTS

Table1. Components identified using GC-MS analysis of three different package.

Rt	PP/PA	Rt	PP	Rt	PLA
4.25	2-Methyl-1-pentene	14.13	Hexanal	16.25	1-Methoxy-2-propanol
5.58	2,4-Dimethyl-heptane	16.08	1-Methoxy-2-propanol	26	6-Methyl-5-hepten-2-one
6.15	2,3-Dimethyl-heptane	18.89	Heptanal	28.5	Nonanal
6.43	4-Methyl-octane	28.5	Nonanal	31.23	Acetic acid
8.97	2-Methyl-nonane	31.23	Acetic acid	33.05	Decanal
10.31	3,3-Dimethyl-octane	32.5	2-Ethyl-1-hexanol	34.8	Propanoic acid
11.83	4-Ethyl-decane	38.01	3,5-Dimethyl-2-cyclohexen-1-one		

Rt*; Retention time

Emitted VOCs, were different according to the material; in particular PP/PA emitted the greatest number of VOCs, most of them belonging to the class of branched alkanes, such as 4-methyl-heptane, 2,4-dimethyl-heptane, 4-methyl-octane; PP emitted heptanal, propanoic acid, acetic acid; PLA emitted acetic and propanoic acids. PP/PA VOCs (2,4-Dimethyl-heptane, hexanal) were found also into the atmosphere of the PP bags with and without fresh-cut artichokes. Furthermore, most of the plastic-related VOCs were detected also on packaged products (Acetic Acid, 2,4-Dimethyl-heptane, Propanoic acid), while they were not found in fresh artichokes, suggesting that a study on the emission of VOCs from different plastic materials in contact with food and on the effect of different storage conditions is very critical for a better understanding of this issue.

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REFERENCES

1. Borsini, Ariel A., et al. "Artichoke by products as a source of antioxidant and fiber: How it can be affected by drying temperature." Foods 10.2 (2021): 459.
2. Ubeda, S., M. Aznar, and C. Nerín. "Determination of volatile compounds and their sensory impact in a biopolymer based on polylactic acid (PLA) and polyester." Food chemistry 294 (2019): 171-178.