

Analysis of volatile organic compounds in packaging of mozzarella cheese and yogurt

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Food Contact Materials (FCMs) are defined as materials and objects directly in contact with food (cooking utensils and tableware, containers, machinery for food processing, packaging materials ...).

Dairy products are usually sold in packaging made of polymeric materials. These are able to release undesirable substances in food modifying its characteristics and organoleptic properties → diffusion phenomena!

The regulations of the plastic food contact materials set up:

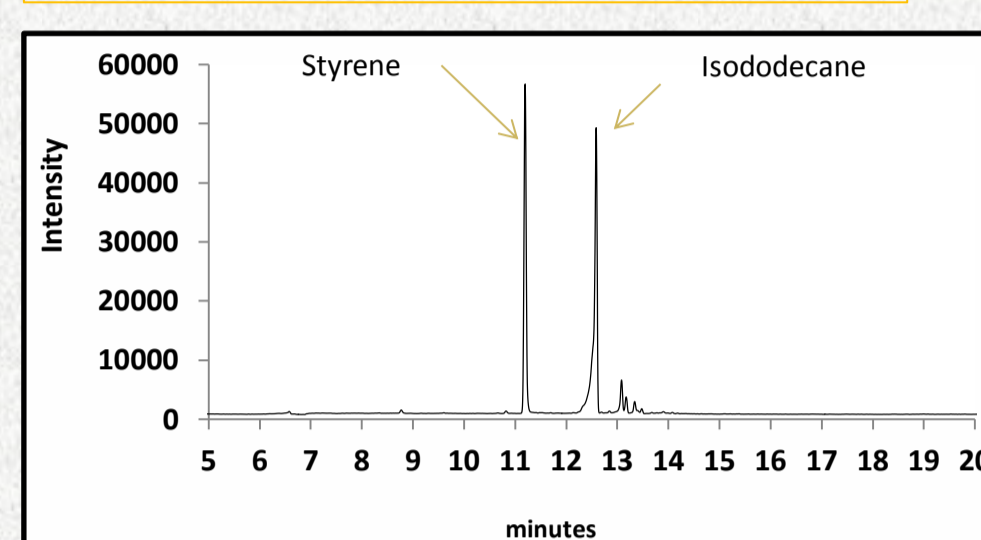
- ❖ list of authorized substances, specific migration limits (SML), and restriction conditions for some substances.
- ❖ maximum overall migration limits (OML) for the plastic food contact materials → 60 mg/kg food.

If some substances are not included, the EU Member States set their own national provisions.

Aim of the work:

- ❖ Determination of styrene and isododecane released from plastic material packaging in mozzarella cheese and yogurt (and the other organic volatile substances).

To this end, analytical method was studied.



The analyses were made by P&T-GC-MS with cryogenic trap.

Quantitative analysis of styrene and isododecane was performed both at room temperature and at 70 °C.

Qualitative analyses were also carried out.

Samples:

- Mozzarella cheese: packaging and food
- Yogurt: packaging and food.



- The mozzarella packaging was made of polyethylene and nylon
- The yogurt packaging was made of polystyrene.

Quantitative analysis:

Yogurt		
Packaging		
	Styrene mg/dm ²	Isododecane mg/dm ²
Sample 1	115 · 10 ⁻⁶	<0.3 · 10 ⁻⁶
Sample 2	678 · 10 ⁻⁶	6.1 · 10 ⁻⁶
Sample 3a	1348 · 10 ⁻⁶	9.2 · 10 ⁻⁶
Sample 3b	1213 · 10 ⁻⁶	9.1 · 10 ⁻⁶
Sample 4a	1132 · 10 ⁻⁶	9.9 · 10 ⁻⁶
Sample 4b	1911 · 10 ⁻⁶	8.8 · 10 ⁻⁶
Sample 4c	3282 · 10 ⁻⁶	10.2 · 10 ⁻⁶
Food		
	Styrene mg/kg	Isododecane mg/kg
Sample 1	0.03 · 10 ⁻³	<0.05 · 10 ⁻³
Sample 2	0.02 · 10 ⁻³	<0.05 · 10 ⁻³
Sample 3	0.4 · 10 ⁻³	<0.05 · 10 ⁻³
Sample 3b	0.4 · 10 ⁻³	<0.05 · 10 ⁻³
Sample 3c	0.3 · 10 ⁻³	<0.05 · 10 ⁻³
Sample 4a	0.4 · 10 ⁻³	<0.05 · 10 ⁻³
Sample 4b	0.3 · 10 ⁻³	<0.05 · 10 ⁻³

Mozzarella cheese					
Packaging			Food		
25 °C					
	Styrene mg/dm ²	Isododecane mg/dm ²		Styrene mg/kg	Isododecane mg/kg
Sample 1a	< 0.1 · 10 ⁻⁶	0.82 · 10 ⁻⁶	Sample 1	< 0.12 · 10 ⁻³	< 1.3 · 10 ⁻³
Sample 1b	1.08 · 10 ⁻⁶	<0.5 · 10 ⁻⁶	Sample 2a	< 0.12 · 10 ⁻³	< 1.3 · 10 ⁻³
Sample 1c	< 0.1 · 10 ⁻⁶	<0.5 · 10 ⁻⁶	Sample 2b	< 0.12 · 10 ⁻³	< 1.3 · 10 ⁻³
			Sample 2c	< 0.12 · 10 ⁻³	< 1.3 · 10 ⁻³
			Sample 2d	< 0.12 · 10 ⁻³	< 1.3 · 10 ⁻³
70 °C					
Sample 1	0.14 · 10 ⁻⁶	0.90 · 10 ⁻⁶			
Sample 2a	0.13 · 10 ⁻⁶	35.8 · 10 ⁻⁶	Sample 2a	0.11 · 10 ⁻³	0.35 · 10 ⁻³
Sample 2b	0.13 · 10 ⁻⁶	13.6 · 10 ⁻⁶	Sample 2b	0.11 · 10 ⁻³	< 0.3 · 10 ⁻³
Sample 2c	0.33 · 10 ⁻⁶	22.7 · 10 ⁻⁶	Sample 2c	0.09 · 10 ⁻³	< 0.3 · 10 ⁻³
Sample 3a	0.46 · 10 ⁻⁶	15.0 · 10 ⁻⁶	Sample 3a	0.14 · 10 ⁻³	< 0.3 · 10 ⁻³
Sample 3b	0.30 · 10 ⁻⁶	13.9 · 10 ⁻⁶	Sample 3b	0.13 · 10 ⁻³	< 0.3 · 10 ⁻³
Sample 3c	0.73 · 10 ⁻⁶	7.1 · 10 ⁻⁶			
Sample 4a	0.50 · 10 ⁻⁶	21.8 · 10 ⁻⁶			
Sample 4b	0.57 · 10 ⁻⁶	16.7 · 10 ⁻⁶			
Sample 4c	0.48 · 10 ⁻⁶	21.3 · 10 ⁻⁶			

Qualitative analysis:

- Mozzarella cheese and packaging: benzaldehyde, alcohols and ketones, aromatics and cyclic, linear and branched aliphatics hydrocarbons, in particular **isododecane** → is probably used as a diluent for the radical initiator for the polymerization.
- Yogurt and packaging: toluene, xilenes, propyl - benzene, etyl - benzene, in particular **styrene** → is the polystyrene monomer.

Conclusions

- ❑ The quantitative analysis showed higher amount of isododecane and styrene in the packaging than foods → also for cyclic, linear and branched aliphatic and aromatic hydrocarbon compounds.

However, OML was not exceeded but SML for these compounds does not defined in the regulation → limits should be required for them.

- ❑ Hydrocarbon compounds diffusion from packaging into foods is low.

- ❑ This study highlighted the importance of monitoring the presence of organic volatile compounds since they could be source of human health-related risk during the assumption of the food product.

