

Trends in food contact materials

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Overview

Food packaging is highly essential for protecting and handling food *from farm to fork*. However, packaging is also a source of chemical contamination of food.



Food packaging consists of many different materials and combinations thereof, e.g., plastics, paper and board, metals, glass, adhesives, coatings, printing inks.



Packaging and other items in contact with food – collectively they are known as food contact materials (FCMs).

Types of FCMs

1. Active and intelligent materials and articles

2. Adhesives

3. Ceramics

4. Cork

5. Rubbers

6. Glass

7. Ion-exchange resins

8. Metals and alloys



<https://www.etsy.com/>



<https://www.masilva.pt/en/cork-stoppers/>



<https://www.interempresas.net/>



<https://blog.1ddavis.com/what-exactly-is-a-food-safe-adhesive>



<https://www.dongjuesilicone.com/>



<https://www.diffpack.com/beer-bottle/>



<http://bsrresin.com/>



<https://new-box.com/en/products/food-cans>

9. Paper and board

10. Plastics

11. Printing inks

12. Regenerated cellulose

13. Silicones

14. Textiles

15. Varnishes and coatings

16. Waxes

17. Wood



<https://www.welmpacking.com/>



<https://www.amazon.com/>



<https://www.michaelpackage.com/>



<https://www.risingsunmembranes.com/>



<https://www.aboutmechanics.com/>



<https://m.indiamart.com/>



<https://www.vectormator.io/blog/beer-labels/>



<https://serowar.eu/>



<https://fr.wessling-group.com/>

Legislation on FCMs

Framework Regulation (EC) No 1935/2004

General requirements for all FCM + Mandate for specific measures

GMP Regulation (EC) No 2023/2006

SPECIFIC MEASURES

Materials

Substances

Directive 84/500/EC

Directive 2007/42/EC

Regulation 10/2011

Regulation 1616/2022

Regulation 450/2009

- Ceramics
- Regenerated cellulose film
- Plastics
- Recycled plastics
- Active and intelligent Materials

- *Vinyl chloride monomer*
- Nitrosamines
- BADGE, BFDGE & NOGE

Regulation (EC) 1935/2004

This FRAMEWORK Regulation applies to materials and articles that:

- ⊙ are intended to be brought into contact with food
- ⊙ are already in contact with food
- ⊙ can reasonably be expected to be brought into contact with food



All materials and articles shall be manufactured in compliance with 'good manufacturing practice' (GMP - as defined in Commission Regulation (EC) No. 2023/2006), so that under normal and foreseeable conditions of use **they do not transfer their constituents to food** in quantities which could:

- ⊙ endanger human health; or
- ⊙ bring about an unacceptable change in the composition of food; or
- ⊙ bring about deterioration in the organoleptic characteristics (i.e. texture, taste, aroma)

FCAs – FCMs - FCCs

FCAs – Food contact articles FCMs – Food contact materials FCCs – Food contact chemicals



FCA

HDPE
LDPE
PET
Adhesives
Printing inks
....

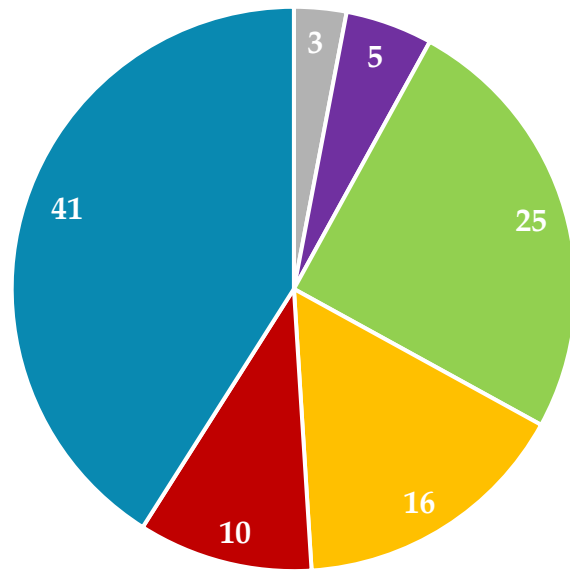
FCM

Additives
Pigments
Oligomers
Degradation products
Contaminants
....

FCC

FCCs migrating from PET bottles

193 FCCs have been investigated, of which 150 have been detected at least once.



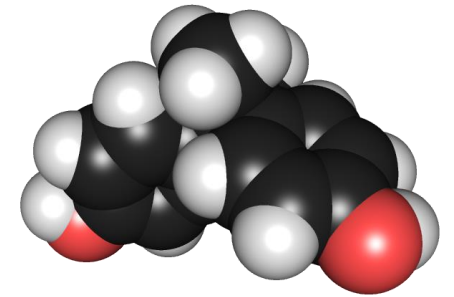
Contribution of each FCCs type to the total number of FCCs that have been detected to migrate from PET drink bottles into food simulant/food sample.

- Catalysts / Co-catalysts (IAS)
- Monomers / Co-monomers (IAS)
- Degradation / Reaction products (NIAS)
- Additives (IAS)
- Oligomers (NIAS)
- Residual contaminants (NIAS)

Bisphenol A (BPA)

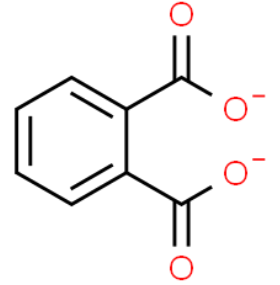
Health risks

Reproductive effects (erectile dysfunction, miscarriage, infertility), cardiovascular diseases, thyroid, immune and metabolic diseases (diabetes), childhood/general/ abdominal obesity, hypertension, neurodevelopment impairments, respiratory conditions, behavior alterations (anxiety, hyperactivity, depression).



BPA is banned for use in plastic baby bottles in the EU. Products labelled “BPA free”, however, can contain alternative bisphenols such as bisphenol S or bisphenol F, which are similar in structure to BPA and can have similar negative health effects.

Phthalates



Health risks

Reproductive toxicity, cancer, insulin resistance and type II diabetes, obesity, allergies and asthma. Phthalates can affect IQ, hyperactivity, and social communication in children, and prenatal phthalate exposures may have neurodevelopmental consequences, damage children's brain development (leading to attention, learning and behavioral disorders).

Used as plasticizers, in items made of polyvinyl chloride (PVC).

Paper packaging can also contain phthalates.

Other food contact materials have also been shown to leach phthalates into food.

Source: Food Packaging Forum. (2012) Phthalates. www.foodpackagingforum.org/foodpackaginghealth/phthalates

Benjamin, S. et al. (2017) Phthalates impact human health: epidemiological evidences and plausible mechanism of action. *Journal of hazardous materials*, 340, 360-383.

Ejaredar, M. et al. (2015) Phthalate exposure and children's neurodevelopment: A systematic review. *Environmental Research*, Volume 142.

Engel, S. M. et al. (2021) Neurotoxicity of Ortho-Phthalates: Recommendations for Critical Policy Reforms to Protect Brain Development in Children. *American Journal of Public Health*, (0), e1-e9.

Perfluoroalkyl and Polyfluoroalkyl Substances (PFAs)

Health risks

Thyroid disease, increased cholesterol levels, liver damage, kidney cancer, testicular cancer, delayed mammary gland development, lower birth weight, reduced response to vaccines.

Polyfluorinated and Perfluorinated Compounds — usually referred to as PFAS — consist of a group of more than 4,700 chemical substances used for their oil-, stick- or stain-repellent properties in the manufacturing of a large array of products and applications.

Plastics

Plastics can transfer chemicals into packaged food or beverages

↓
migration



Overall migration

List of food simulants

Food simulant	Abbreviation
Ethanol 10 % (v/v)	Food simulant A
Acetic acid 3 % (w/v)	Food simulant B
Ethanol 20 % (v/v)	Food simulant C
Ethanol 50 % (v/v)	Food simulant D1
Any vegetable oil containing less than 1 % unsaponifiable matter	Food simulant D2
poly(2,6-diphenyl-p-phenylene oxide), particle size 60-80 mesh, pore size 200 nm	Food simulant E









Food Packaging
Laboratory



OML = 10 mg/dm²

Overall migration testing

OVERALL MIGRATION TESTING EU REGULATION 10/2011	TEST: OM1  10 days at 20°C	TEST: OM2  10 days at 40°C
	For frozen and refrigerated food contact	For any long term storage at room temperature or below
TEST: OM3 2 hours at 70°C  OR 15 mins at 100°C	TEST: OM4 1 hour at 100°C 	TEST: OM5 2 hours at 100°C OR 1 hour at 121°C
For any contact conditions, which are not followed by any long term storage	For high temperature applications, up to 100 °C	For high temperature applications, up to 121°C
TEST: OM6  4 hours at 100°C	TEST: OM7  2 hours at 175°C	
For any food contact conditions with food simulants A,B or C, at temperature >40°C	For high temperature applications with fatty foods - exceeding OM5	



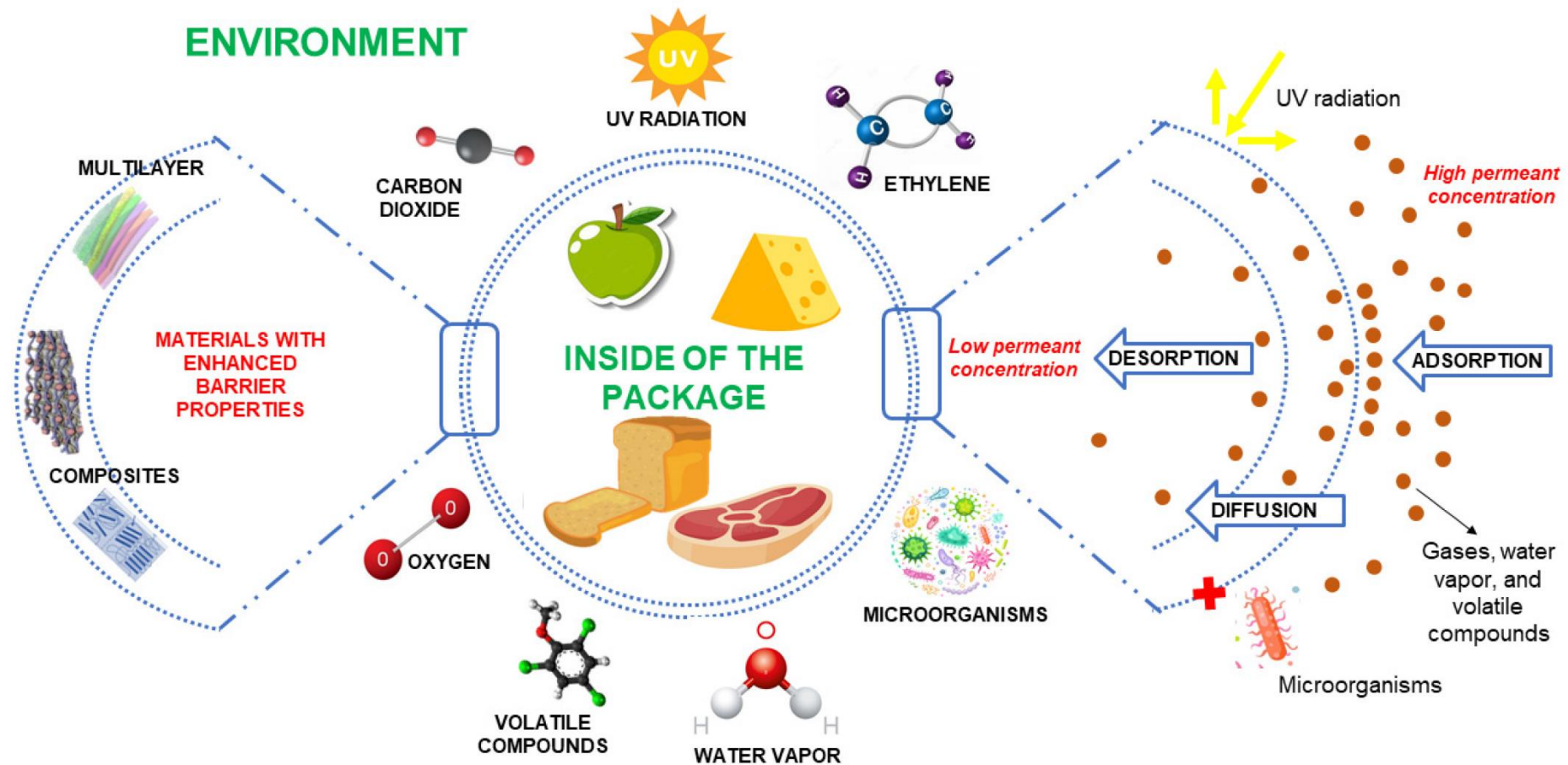
Source: SMITHERS PIRA

Food simulant assignment

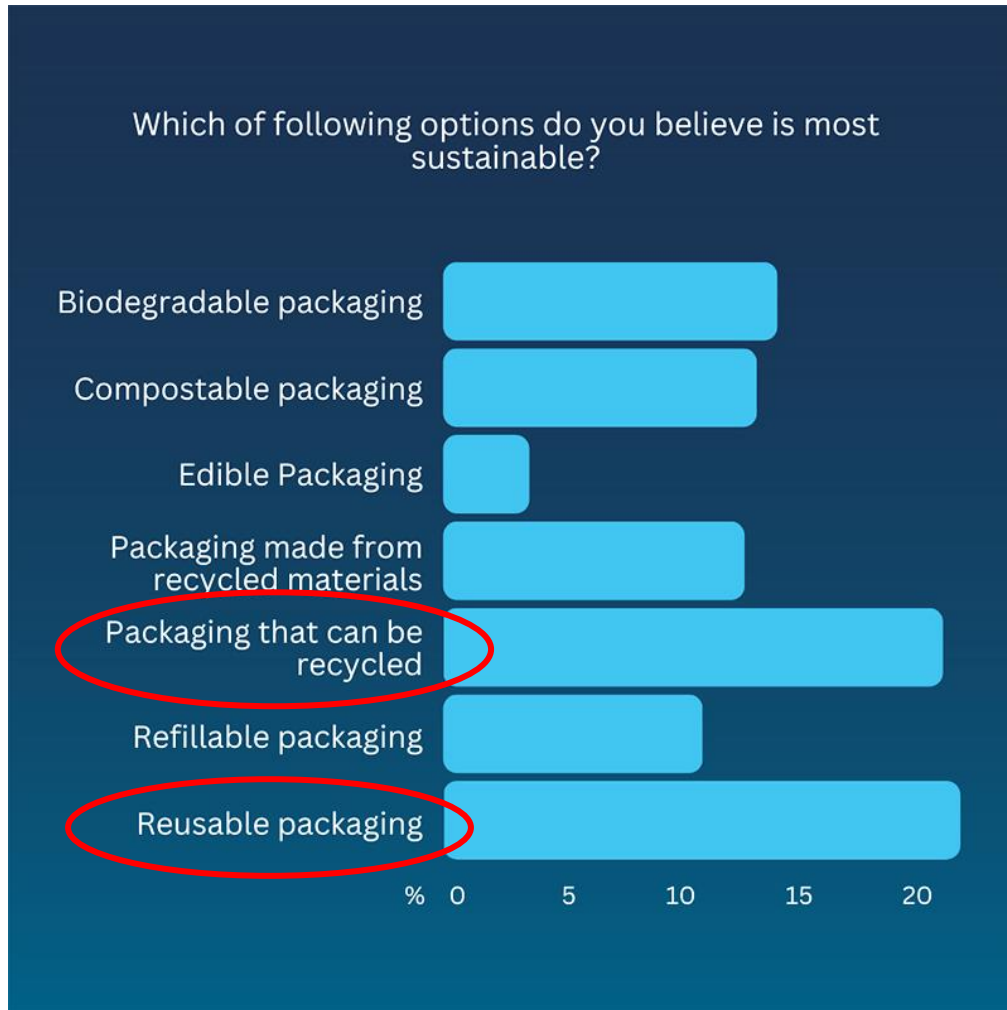


Foods covered	Food simulants in which testing shall be performed
all types of food	food simulant A, food simulant B and food simulant D2
all types of food except for acidic foods	food simulant A and food simulant D2
all aqueous and alcoholic foods and milk products with a pH \geq 4,5	food simulant D1
all aqueous and alcoholic foods and milk products with a pH $<$ 4,5	food simulant D1 and food simulant B
all aqueous foods and alcoholic foods up to an alcohol content of 20 %	food simulant C
all aqueous and acidic foods and alcoholic foods up to an alcohol content of 20 %	food simulant C and food simulant B

How packaging protects food from external agents



Sustainability



Recyclable and reusable packaging are most commonly viewed as sustainable by consumers.

Recyclable and reusable packaging options are not only viewed as sustainable by consumers but are also integral to a more environmentally friendly and responsible lifestyle. These choices not only benefit individuals by saving money and reducing waste but also contribute to a broader global effort to protect the planet.

Polycymakers recommendations



Thoroughly assess,
measure and control
chemicals in food
contact materials,
including food packaging.

Risk Assessment

Regulatory Compliance

Material selection

Migration testing

Quality control

Documentation and Traceability

Continuous Monitoring and Improvement

Policymakers recommendations



Prohibit known substances of concern in all food contact materials, to protect health and prevent toxic recycling.

Polycymakers recommendations



Improve transparency and traceability of chemicals throughout the supply chain, including recycling processes, and throughout the supply chain, including recycling processes and at the point of sale.

Polycymakers recommendations



Set the same standards for primary and recycled food contact materials, to guarantee the same level of safety and build consumer trust in recycled materials.

Polycymakers recommendations

Ensure that food packaging is designed to be toxic-free, reusable (as much as possible), and recyclable at the end of their life cycle.



As final conclusion

Within the EU there is a strong focus on **promoting the circular economy** that is driving research on many fronts, including overcoming the use of environmentally harmful polymers, the **shift towards bio-based plastics** and **greater recycling and processing of plastic waste**.



