

Ensuring Food Safety: The Role of Packaging and Food Contact Materials

PRESENTED BY

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Food Packaging & Food Contact Materials

- **Food packaging:** refers to the **entire container or wrapping** that holds a food product. Its purpose is to protect, preserve, and communicate information about the food. Think of it as the whole box, bottle, or bag.
- **Food contact material (FCMs):** is any **specific material or article** that **directly touches the food** or is expected to. While the inner layer of food packaging is often an FCM, this category also includes things like kitchen utensils, plates, and processing equipment.



The key concern with FCMs is ensuring that no harmful substances migrate into the food.



Food Contact Materials (FCMs) and Consumer Safety

- **Direct Contact**

- Chemicals or particles from the FCM have a direct pathway to enter the food consumed by the consumer

- **Migration Limits**

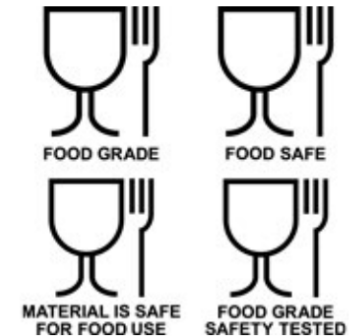
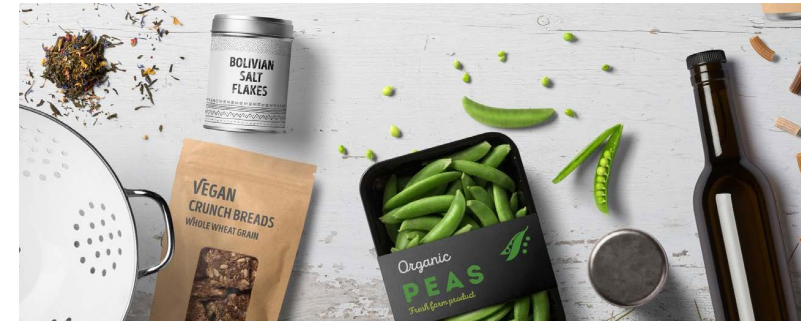
- Regulations specify "maximum allowable amounts of substances that can transfer to food".
- These limits are based on toxicology data to ensure human health safety.

- **Positive Lists**

- lists of approved substances for use
- Only rigorously safety-assessed substances are permitted.

- **Testing**

- FCMs undergo extensive testing (e.g., migration testing) under various conditions to simulate real-world use and ensure compliance



Types Of Food Contact Material



Plastic



Ceramic



Glass



Paper



Wood



Metal



Cork



Textiles



Adhesive



Ink



Silicone



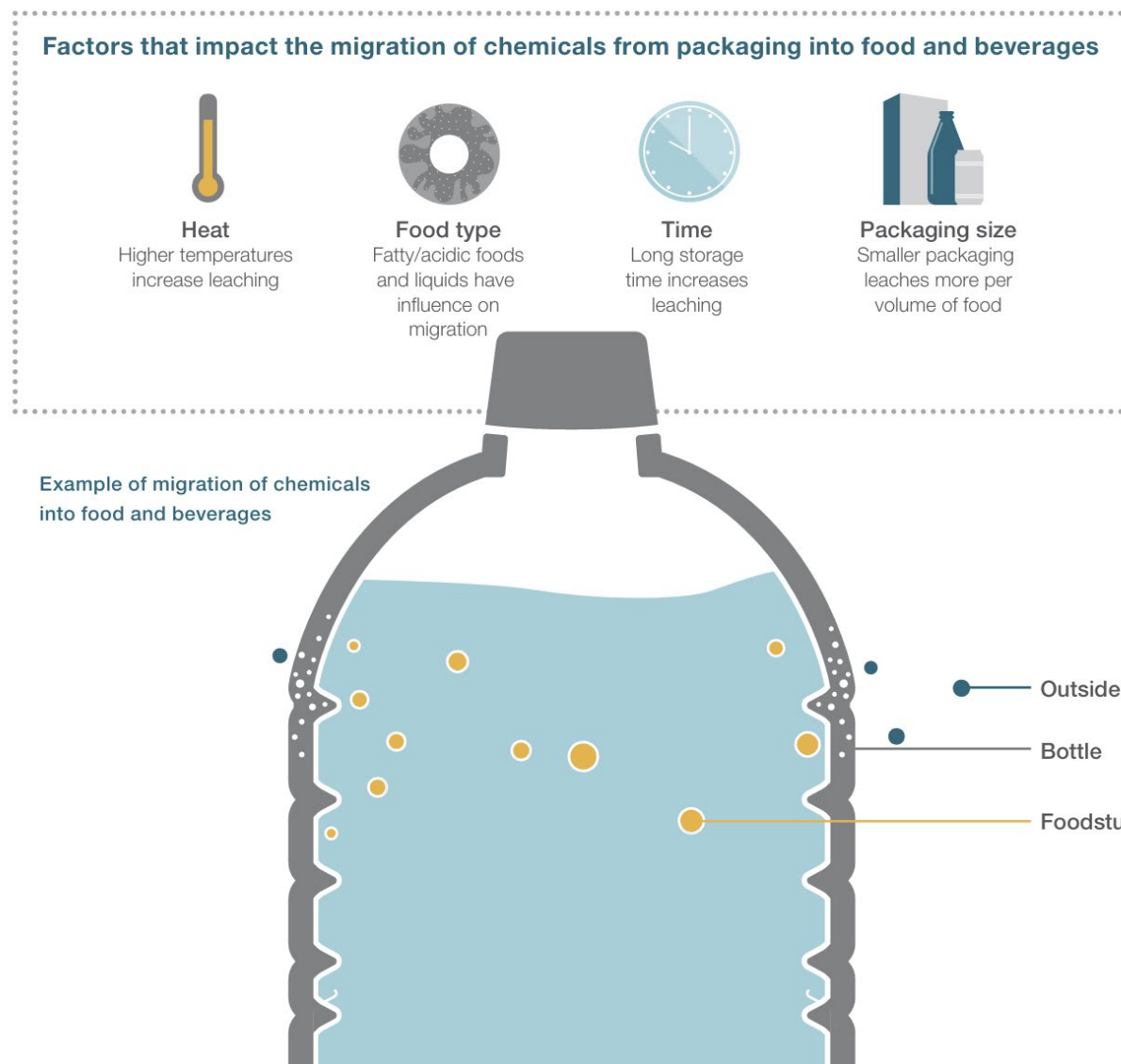
Paint

Migration

Process of compounds leaching from the food contact material into the food or beverage

Overall migration limit (OML)	Specific migration limits (SML)
Max. total quantity of all substances that may migrate from the material into food	Max. permitted quantity of a specific substance that may migrate into food

- The [EU 10/2011 listing for plastics](#) specifies over 1000 compounds that are permitted to be used in food contact material,
- No packaging material is entirely inert
- Due to the size of the pores in various packaging materials the analytes of interest are either volatile or semi-volatile (<1000 Da) in nature



IAS: Intentionally Added Substances

Known and permitted added substances

- Monomer & other starting substances
- Additives
- Polymer production aids
- Aids to polymerization
- Colorants
- Solvents
- Pre-polymers

NIAS: Non-intentionally Added Substances

Inadvertent migration

- Impurities
- Degradation products
- Oligomers
- Reaction
- Byproduct
- Contaminants



Overall Migration Limit (OML) Test

PREPARE TEST SAMPLE

Cut FCM (ex. film, container)
Determine surface area (dm^2)



SELECT FOOD SIMULANTS

Choose to type of food to contact
(95%Ethanol, 10%Ethanol,
3%Acetic acid, etc.)



CONDITION TEST SAMPLE

Expose to worst-case condition
(Ex. 70°C , 2 hr)



MEASURE MIGRATION

Evaporate food simulant
Weight non-volatile residue



CALCULATE OVERALL MIGRATION

Express in mg/dm^3 or mg/kg food

EU Regulation 10/2011, 1935/2004

กฎหมายไทย / อย. (ประกาศกระทรวง 435)

<10 mg/dm^2



Specific Migration Limits (SML) Test

PREPARE TEST SAMPLE

Cut FCM (ex. film, container)
Determine surface area (dm²)

SELECT FOOD SIMULANTS

Choose to type of food to contact
(95%Ethanol, 10%Ethanol,
3%Acetic acid, etc.)

CONDITION TEST SAMPLE

Expose to worst-case condition
(Ex. 70°C, 2 hr)

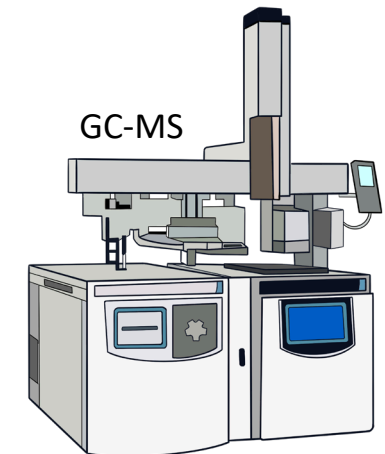
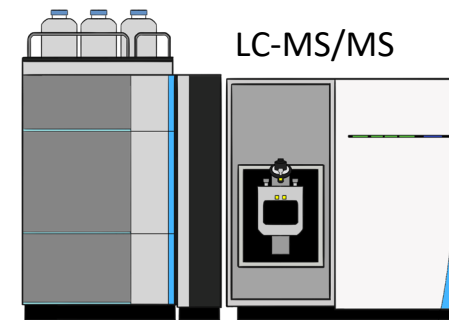
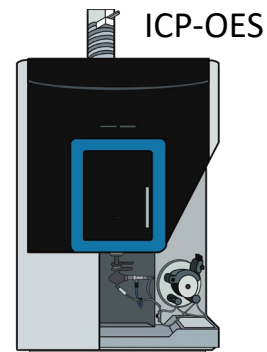
SAMPLE PREPARATION FOR ANALYSIS

Extraction/Preconcentration/Clean-up

SAMPLE PREPARATION FOR ANALYSIS

Introduce sample to highly sensitive and specific analytical instruments to identify and quantify the target substance(s)

- **Heavy metals:** Lead, Cadmium
- **Plasticizers:** Phthalates, Bisphenol A
- **Monomers and additives:** Styrene, Acrylonitrile, Formaldehyde
- **Printing inks and photoinitiators:** ITX, Benzophenone
- **Residuals solvents:** Toluene, xylene
- **Fluorinated substance (PFAS)**



Require analytical instrument

Primary Aromatic Amines (PAAs)

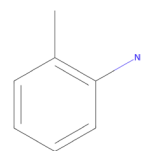
- Organic compounds containing one or more amino groups (-NH₂) attached directly to an aromatic ring
- Starting materials for **azo dye** manufacture and can be added to plastics during production
- Denoted as **carcinogens**
- Often appear as **NIAS**: Degradation of polyurethane (PU) adhesives, impurities or by-products in dyes and printing Inks, monomers in polyamide plastics (nylon), recycled plastics

ประกาศกระทรวงสาธารณสุข ฉบับที่ 435 พ.ศ.2565

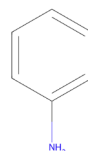
ภาชนะบรรจุที่ทำจากพลาสติกที่มีสีหรือใช้หมึกพิมพ์

ต้องตรวจไม่พบสาร PAAs จำนวน 22 ชนิด

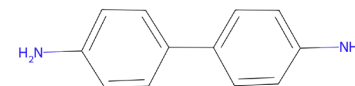
(ที่ขีดจำกัดของการตรวจวัด, Limit of Detection; LOD = 0.002 mg/kg
ของอาหารหรือตัวแทนอาหารจำลอง)



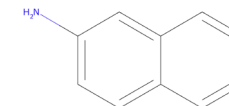
o-toluidine



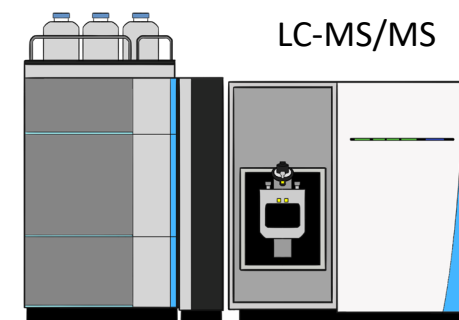
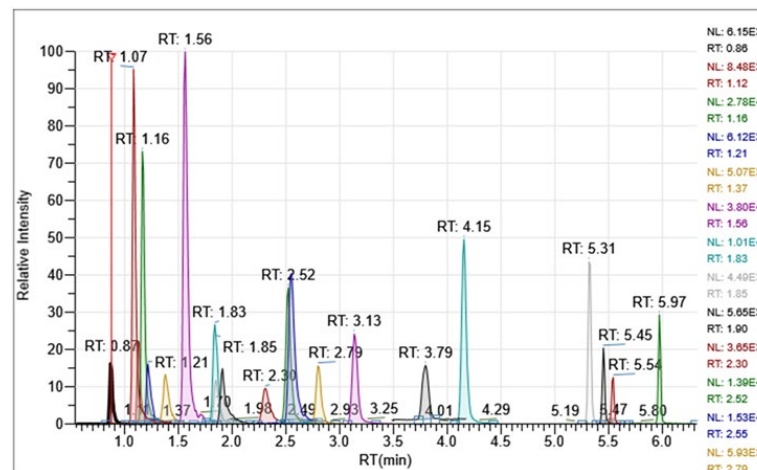
Aniline



Benzidine



2-Naphthylamine



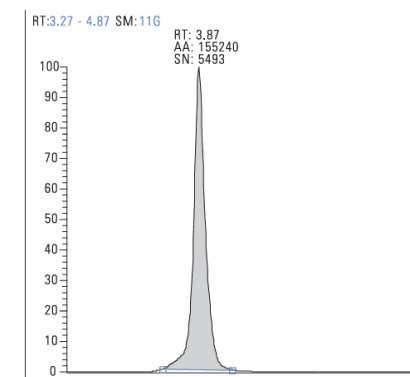
Bisphenol A (BPA)

- Primary monomer used in the intentional synthesis of **polycarbonate (PC) plastics** and a key component in the production of **epoxy resins**, which are deliberately applied as internal coatings for food and beverage cans.
- Classified as an **IAS**
- Classified as an **Endocrine Disrupting Chemical (EDC)** - disrupts the function of sex hormones and thyroid hormones.
- Significantly associated with **heart disease, diabetes, and certain cancers**



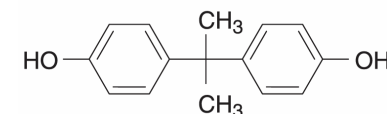
ประกาศกระทรวงสาธารณสุข ฉบับที่ 435 พ.ศ.2565
ภาชนะบรรจุที่ทำจากพลาสติก Polycarbonate
ต้องมีปริมาณ BPA ที่แพร่กระจายสู่อาหารไม่เกิน 0.05 mg/kg

Regulation (EU) 2024/3190, adopted by the European Commission on December 19, 2024, **bans the use of Bisphenol A (BPA) and its salts, along with other hazardous bisphenols and bisphenol derivatives, in food contact materials across the EU**

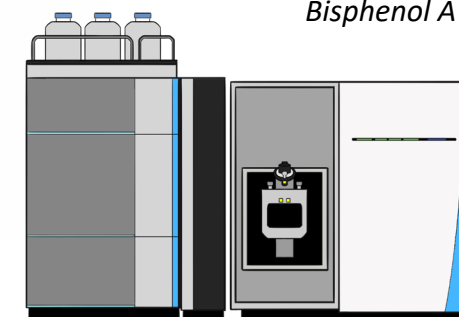


LC-MS/MS

NL: 4.18E4
m/z = 132.04-133.04
P: - c AP01 SRM1 ms2
227.10 [133.14
212.13] MS ICIS
BG_Std8_003



Bisphenol A



Heavy metal

- Primarily from the **raw materials (impurities), manufacturing processes, and sometimes even through recycling**
- Primarily treated as **NIAS**
- Exposure to heavy metals from FCMs, even at low levels over time, can contribute to a range of non-communicable diseases, developmental problems, and organ damage.



ประกาศกระทรวงสาธารณสุข ฉบับที่ 435 พ.ศ.2565

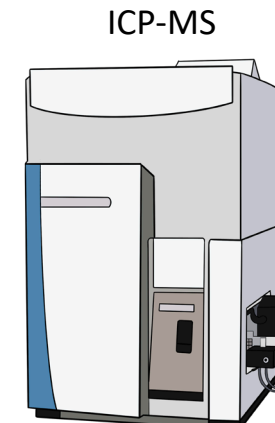
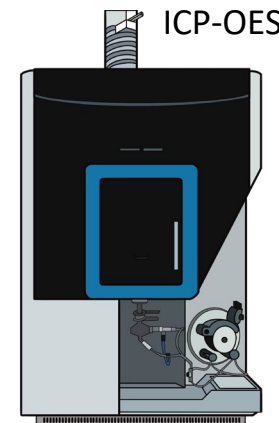
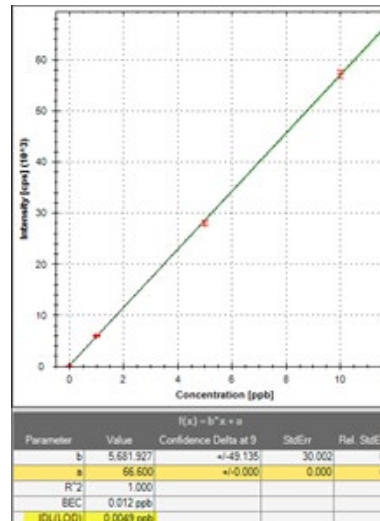
ภาชนะบรรจุที่ทำจากพลาสติกแต่ละชนิด

ต้องตรวจรายการโลหะหนัก 19 รายการ

โดยต้องตรวจไม่พบหรือไม่เกินปริมาณสูงสุดที่ยอมให้

แพร่กระจายสู่อาหาร

(ปริมาณแตกต่างกันตามโลหะหนักแต่ละชนิด)



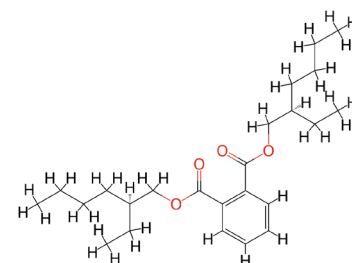
Lead	Pb
Aluminium	Al
Barium	Ba
Cobalt	Co
Copper	Cu
Iron	Fe
Lithium	Li
Manganese	Mn
Nickel	Ni
Zinc	Zn
Antimony	Sb
Arsenic	As
Cadmium	Cd
Chromium	Cr
Mercury	Hg
Europium	Eu
Gadolinium	Gd
Lanthanum	La
Terbium	Tb

Phthalate

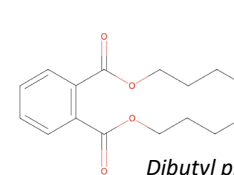
- Primarily used as **plasticizers** to make plastics (especially PVC) flexible, soft, and durable.
- Main Sources in food packaging: **PVC** such as cling films/stretch films and plastic gaskets in jar/bottle caps, coatings, printing inks
- Classified as an **IAS**
- Highly **likely to be found in fat containing foods** due to their lipophilic nature
- reported to act as **endocrine disruptors**, and exposure to high levels can cause harmful effects in the **human reproductive system**

Regulation (EU) No 10/2011 (The Plastics Regulation)

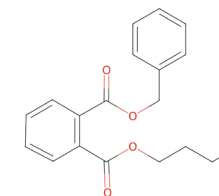
- DEHP (Di-ethylhexyl phthalate): <6.0 mg/kg (in certain cases)
- DBP (Dibutylphthalate): <0.12 mg/kg
- BBP (Benzyl Butyl Phthalate): <6.0 mg/kg (in certain cases)
- DINP (Diisononyl phthalate) and DIDP (Diisodecyl phthalate):
Have combined usage restrictions and SMLs (e.g., combined SML of 9 mg/kg).



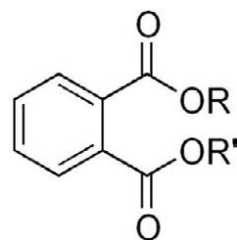
Di(2-ethylhexyl) phthalate (DEHP)



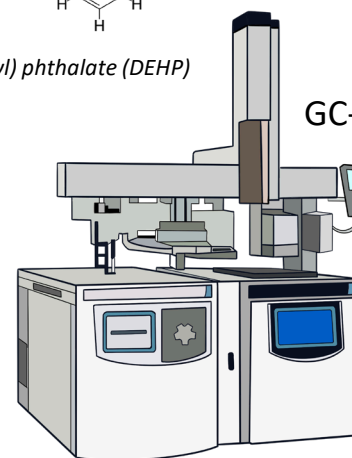
Dibutyl phthalate (DBP)



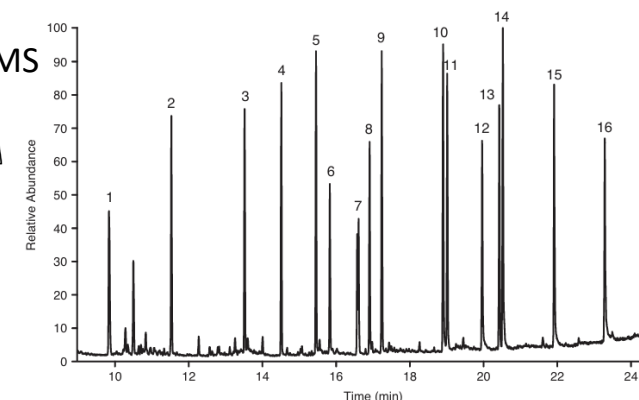
Benzyl butyl phthalate (BBP)



Phthalate structure



GC-MS



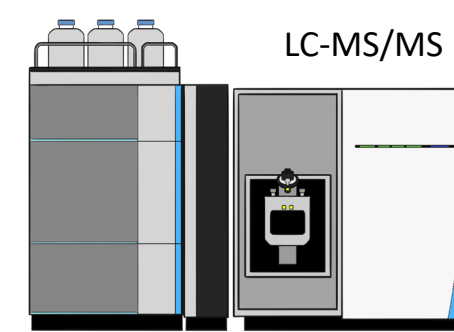
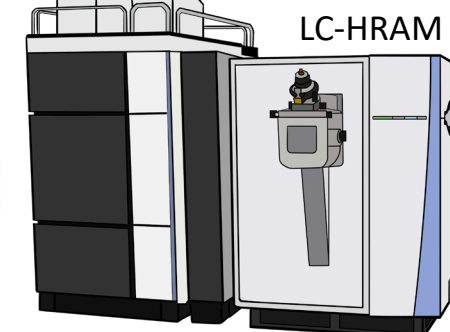
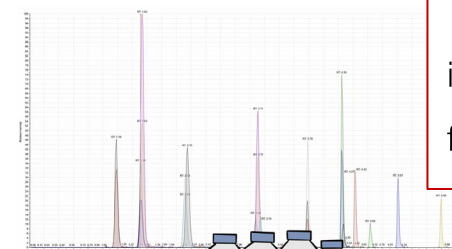
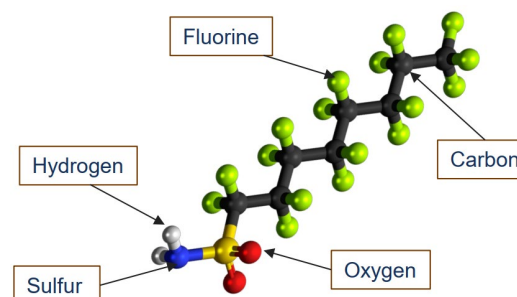
1	Dimethylphthalate	DMP
2	Diethylphthalate	DEP
3	Benzyl benzoate (Internal standard)	ISTD
4	Diisobutyl phthalate	DIBP
5	Di-n-butyl phthalate	DBP
6	Bis(2-methoxyethyl) phthalate	DMEP
7	Bis(4-methyl-2-pentyl) phthalate	BMPP
8	Bis(2-ethoxyethyl) phthalate	DEEP
9	Dipentylphthalate	DPP
10	Di-n-hexyl phthalate	DHXP
11	Benzyl butyl phthalate	BBP
12	Bis(2-n-butoxyethyl) phthalate	DBEP
13	Dicyclohexyl phthalate	DCHP
14	Bis(2-ethylhexyl) phthalate	DEHP
15	Di-n-octyl phthalate	DNOP
16	Di-nonyl Phthalate	DNP



Per- and polyfluoroalkyl substances (PFAS)

- Used globally in many industries and comprise thousands of individual compounds.
- Classified as **IAS** for decades to **confer grease and water repellency**
- **Forever chemicals**: Highly persistent, bioaccumulative, and toxic.
- Uses of PFAS in FCM:
 - Paper/Paperboard Packaging**: Used for fast-food wrappers, microwave popcorn bags, pizza boxes, fried chicken boxes, and bakery bags.
 - Coatings**: Applied as non-stick coatings on cookware (e.g., Teflon™, which is a type of PFAS called PTFE)
- Health Concerns from PFAS Exposure: accumulate in the body. Even low-level, long-term exposure is linked to issues like weakened immunity, thyroid problems, liver damage, increased cholesterol, reproductive and developmental harm, and an elevated cancer risk.

European Union (EU): Is actively pursuing a comprehensive ban on PFAS in FCMs. New legislation (e.g., EU Packaging and Packaging Waste Regulation - PPWR) aims to **restrict PFAS levels in food packaging**, with new limits expected to apply from August 2026. These limits include thresholds for individual PFAS compounds and total fluorine content.



- **Food Contact Materials (FCMs):**
 - can be a source of chemical substances that migrate into food, which may pose health risks to consumers.
- **Migration:** Transfer of substances from packaging into food, influenced by temperature, time, food type, and material properties.
 - OML (Overall Migration Limit): Total allowable migration.
 - SML (Specific Migration Limit): Limit for specific substances.
- **Selection of appropriate analytical technique for different migration species**

Migrants	Instrumental technique								
	GC	HS GC-MS	GC-MS	LC-MS/MS	ICP-MS	LC-Orbitrap	GC-Orbitrap	DART- MS	LC-GC
Monomers	X	X	X				X		
Plasticizers			X					X	
Additives			X	X		X	X	X	
Mineral oils	X								X
Cr, Ni, Mn, Sb					X				
BADGE				X			X		
BPA			X	X					
PAA's				X				X	
Untargeted						X	X	X	

Control Measures:

- Regulatory limits (e.g., EU Regulation 10/2011)
- Routine migration testing
- Safe material selection and compliance checks