Intentionally and non-intentionally added substances from plastic packaging materials: a short review

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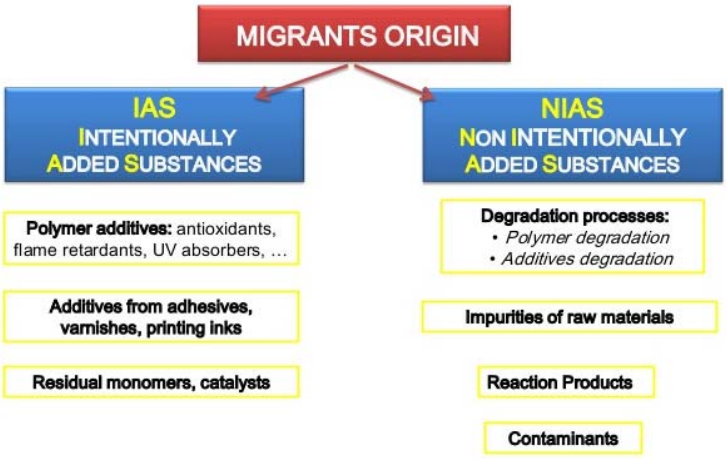

Fig. 1. IAS and NIAS contamination sources [3]

Abstract

Food contact materials (FCMs) are used to obtain food contact articles (FCAs), including food packaging, food storage containers, food processing equipment, but also, machinery, kitchen- and tableware, that come into contact with food and beverages during, the entire food supply chain. These FCAs and FCMs are made of base materials, like plastics, paper and board, metal or glass, and different chemical substances, intentionally added substances (IAS) or non-intentionally added substances (NIAS), generally known as food contact chemicals (FCCs) [1,2].

Among the FCCs, the most analyzed are bisphenols (such as Bisphenol A), phthalates, such as (2-ethylhexyl) phthalate (DEHP), diethyl phthalate (DEP), diisobutyl phthalate (DIBP), dibutyl phthalate (DBP), formaldehyde, Per- and polyfluoroalkyl chemicals (PFASs), including Perfluorooctane sulfonate (PFOS) and perfluoro-octane acid (PFOA), Primary aromatic amines (PAAs), Mineral oil hydrocarbons (MOHs), including mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH).

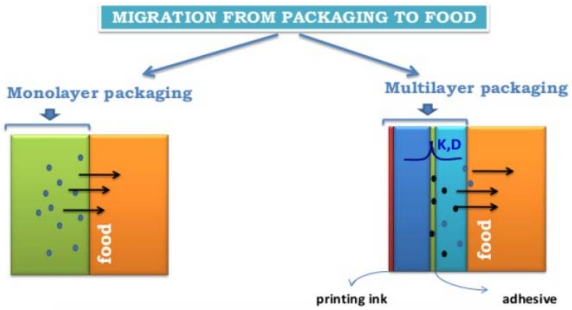

Fig. 2. Migration process of IAS and NIAS in food products [3]

Table 1. Specific migration limit (SML) for some NIAS and IAS [4]

Compound	CAS no	Molecular formula	SML (mg/kg)
Formaldehyde	50-00-0	CH_2O	-
Acetaldehyde	75-07-0	C_2H_4O	-
Vinylidene fluoride, 1,1-difluoroethylene	75-38-7	C_2H_2F2	5
Chlorodifluoromethane	75-45-6	$CHClF_2$	6
tri-n-butyl acetyl citrate (Acetyl tributyl citrate) (ATBC)	77-90-7	$C_{20}H_{34}O_8$	-
2,2-bis(4-hydroxyphenyl) propane (BPA)	80-05-7	$C_{15}H_{16}O_2$	0.05
Diethyl phthalate (DEP)	84-66-2	$C_{12}H_{14}O_4$	-
Phthalic acid, dibutyl ester (Dibutyl phthalate) (DBP)	84-74-2	$C_{16}H_{22}O_4$	0.3
Phtalic acid, benzyl butyl ester (BBP)	85-68-7	$C_{19}H_{20}O_4$	30
1,3-phenylenediamine	108-45-2	$C_6H_8N_2$	ND
Tetrafluoroethylene	116-14-3	C_2F_4	0.05
phthalic acid, bis(2-ethylhexyl) ester (DEHP)	117-81-7	$C_{24}H_{38}O_4$	1.5
Benzophenone (BP)	119-61-9	$C_{13}H_{10}O$	0.6
2,6-di-tert-butyl-p-cresol (Butylated hydroxytoluene) (BHT)	128-37-0	$C_{15}H_{24}O$	3
4,4'-difluorobenzophenone	345-92-6	$C_{13}H_8OF_2$	0.05
Perfluoromethyl perfluorovinyl ether	1187-93-5	C_3F_6O	0.05
1,3-benzenedimethanamine	1477-55-0	$C_8H_{12}N_2$	0.05
Perfluoropropyl perfluorovinyl ether	1623-05-8	$C_5F_{10}O$	0.05
2,2'-ethylidenebis(4,6-di-tertbutylphenyl) fluorophosphonite	118337-09-0	$C_{30}H_{44}FO_2P$	6
4,4'-methylenebis(3-chloro2,6-diethylaniline)	106246-33-7	$C_{21}H_{28}Cl_2N_2$	0.05

ND – not detectable

Conclusion

With increasing complexity of FCMs and FCAs, NIAS will continue to be an important research topic. Advances in analytical techniques will facilitate the detection and identification of food contact chemicals and comparative analysis with the legal requirements will be done. It is very important, also, to focus on the risk assessment of those chemicals, and other new ones, on human health by in vivo and in vitro testing, to know better the side effects of these substances.

References

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[2] Munche J., Andersson A. M., Scheringer M. (2020). Impacts of food contact chemicals on human health: a consensus statement, Environmental Health, vol. 19, article numer 25.
[3] https://www.slideshare.net/WatersChemical/harnessing-the-power-of-ccs-for-routine-screening-applications-on-the-unifi-informatics-platform
[4] COMMISSION REGULATION (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food

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