Packaging safety aspects of paper in food Packaging applications

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Packaging is the act of enclosing or protecting the product using a container to aid its distribution, identification, storage, promotion, and usage.

Function of Packaging

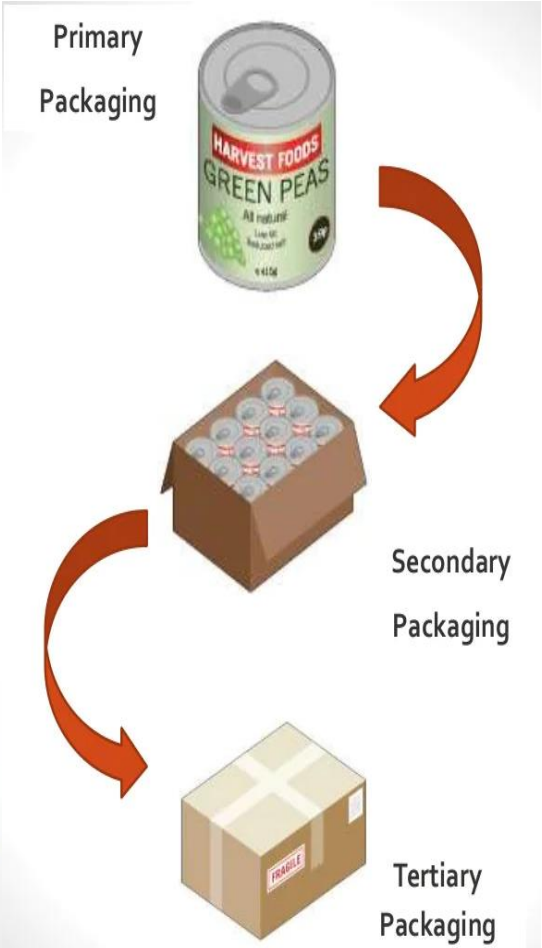
- **Containment**: For consolidation of unit load for shipping.
- **Protection:** Protect the product during transportation.
- **Preservation:** Longevity
- **Information:** Silent “salesman”
- **Convenience:** Comfort.

Selection Criteria For Packaging Material

- The product or pack contents.
- The application of the product
- Content stability and the need of protection from any environmental factors.
- Content reactivity(with relevant to packaging material.)
- Acceptability of pack to the consumer or user
- The packaging process
- Regulatory, legal and quality issues.

Types of Packaging

- ***Primary packaging*** *is the material that first envelops the product and holds it. This usually is the smallest unit of distribution or use and is the package which is in direct contact with the contents.*
- ***Secondary packaging*** *is outside the primary packaging, perhaps used to group primary packages together.*
- ***Tertiary packaging*** *is used for bulk handling, warehouse storage and transport shipping. The most common form is a palletized unit load that packs tightly into container*



Types of Paper Food Packaging Materials

- Kraft paper
- Bleached paper
- Greaseproof paper
- Glassine paper
- Waxed paper
- Sulfite paper

- Paperboard
- Paper bags
- Composite cans
- Fibre drums
- Multiwall paper sacks
- Rigid boxes
- Folding cartons
- Corrugated fibreboard (CFB)

PAPER AND PAPER BOARD

- Paper is an excellent packaging material (renewable, biodegrdable and recyclable) but, poor barrier properties low strength and heat sealability retards its application
- Improving paper's barrier properties is needed to increase its viability as packaging material.

1. Wax impregnation:

- kraft paper impregnated with paraffin.

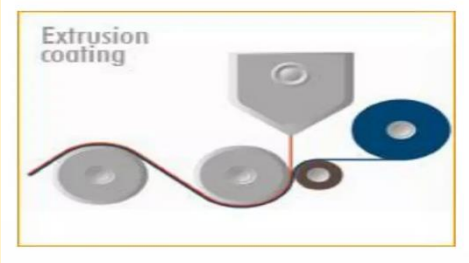
- The main protective characteristics of this are its **impermeability** to water, preserve strength and **puncture resistance**.

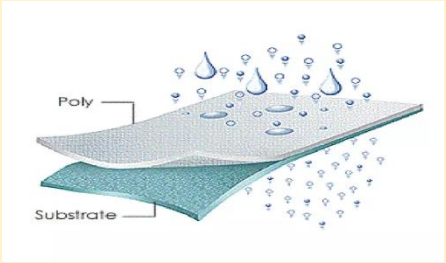
Disadvantage:

a. Paraffin wax is a non renewable petroleum based material
b. Migration of the wax increased at higher temperatures

2. Extrusion coating: PE, PP, HDPE

- Polymers are widely used for providing moisture and gas resistance, sealing properties





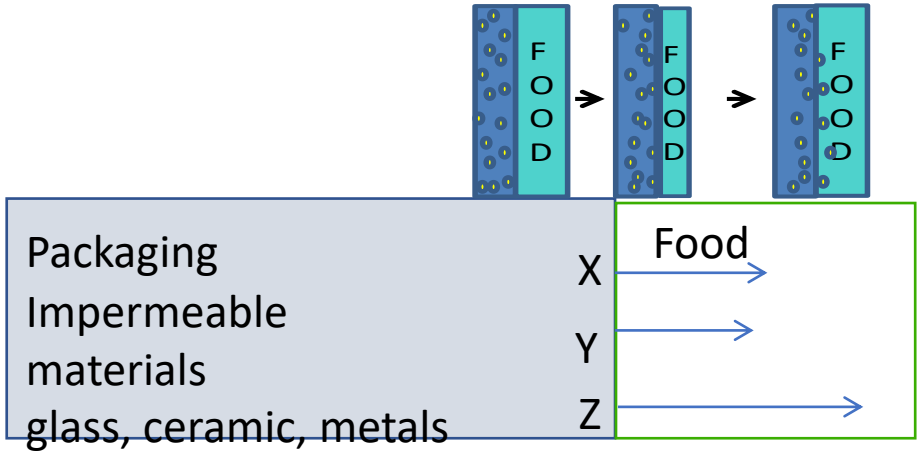
- **PET coated paper board**: thermoformed paper based trays, microwavable trays, folding cartons
- **Nylon coated paper board:** Corrugated boxes
- PLA coated paperboard: compostable paper bags, take-out box.

PLASTIC FOOD PACKAGING MATERIALS

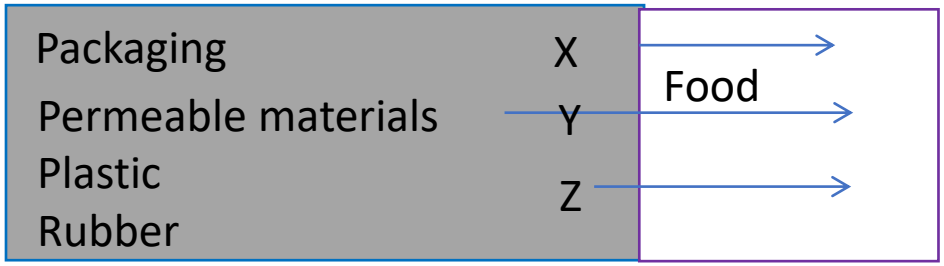
- Polyethylene terephthalate (PET)
- High-density polyethylene (HDPE)
- Polyvinyl chloride (PVC)
- Low-density polyethylene (LDPE)
- Polypropylene (PP)
- Polystyrene (PS)

Migration

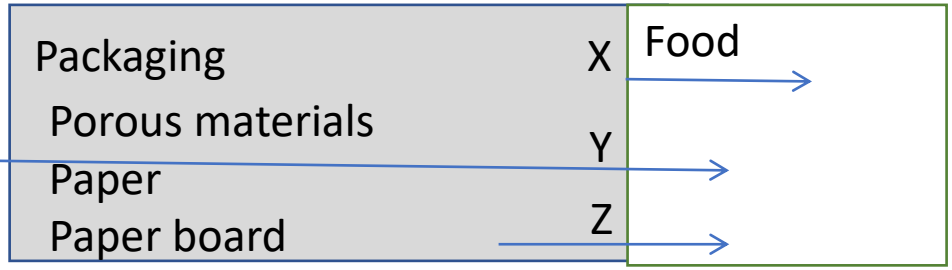
"Migration" refers to the diffusion of substances from a zone of higher concentration (the food-contact layer) to one of a lower concentration (usually the food surface).



Chemical migration from Impermeable Material



Chemical migration from Permeable Material



Chemical migration from and through a Porous Material

- **Temperature**
- **pH**
- **Light**
- **Mechanical**

TYPES OF MIGRATION

Overall migration or global additive migration

Total amount of substance migrating from plastics into food

Estimated by gravimetric method.

BIS: 10 mg/dm^2; 60 ppm (mg/kg)

USFDA : 0.5 mg/in^2; 50 ppm

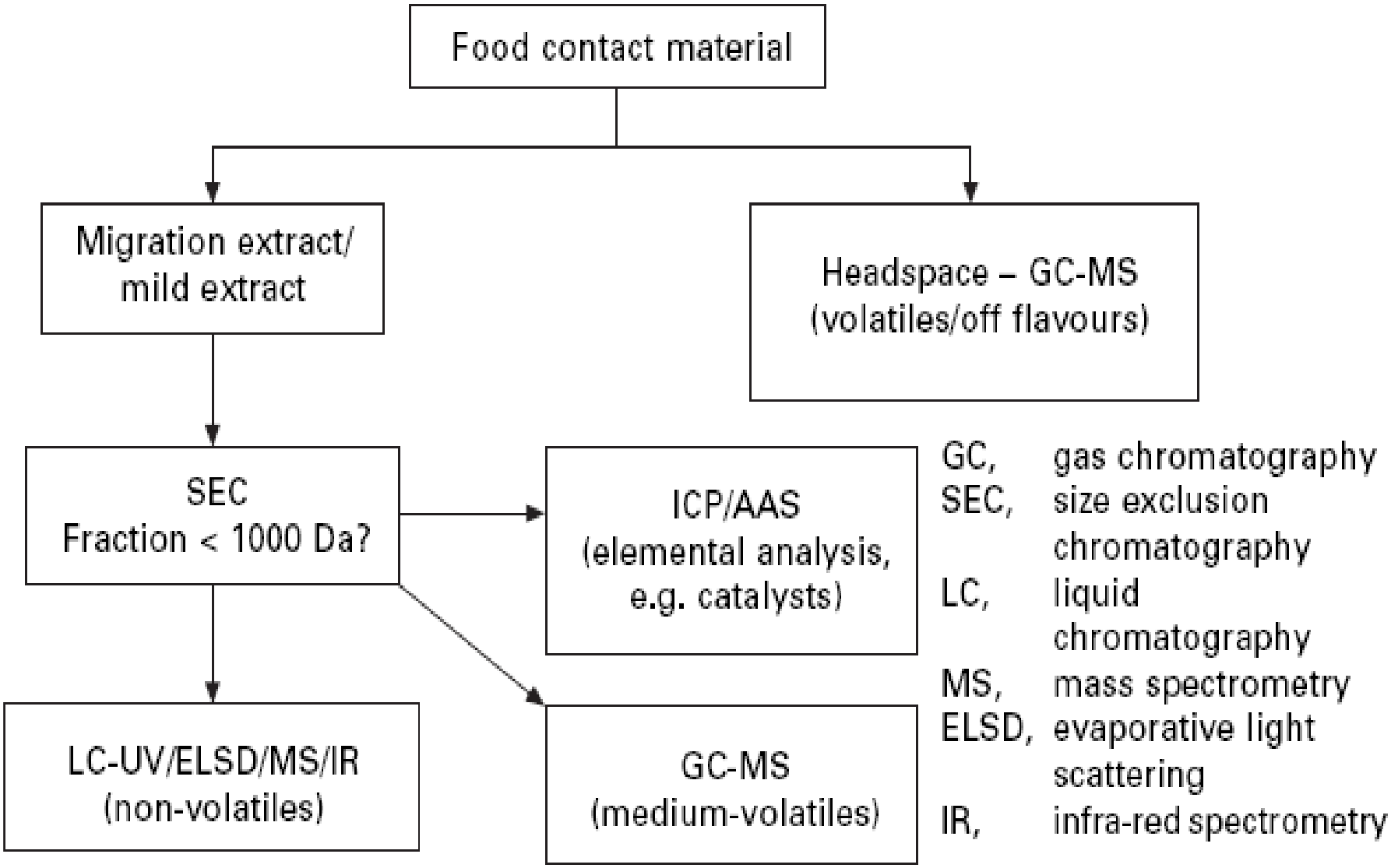
Specific additive migration

Specific migration is the amount of a specific component that migrates from the food contact material to the food during contact

Example: BPA, Phthalates, Plasticizers

EU 10/2011

Migration analysis



- Regulation (EC) No 1935/2004 of the European parliament and of the council of 27 October 2004 on materials and articles intended to come into contact with food,
- Commission regulation (EC) No 1895/2005 of 18 November 2005 on the restriction of use of certain epoxy derivatives in materials and articles intended to come into contact with food,
- Commission regulation (EC) No 2023/2006 of 22 December 2006 on good manufacturing practice for materials and articles intended to come into contact with food,
- Commission direvtive 2007/42/EC of 29 June 2007 relating to materials and articles made of regenerated cellulose film intended to come into contact with foodstuffs,
- BEUC (July 25, 2019). "The EU needs rules on chemicals in coffee cups, straw and other paper food packaging, consumer test shows."
- Clelia Oziel (July 31, 2019). "Tests in Europe find printing ink chemicals in coloured paper FCMs." *Chemical Watch*
- *Reference*
- BEUC (July 18, 2019). "More than a paper tiger. European consumer organizations call for action on paper and board food contact materials." BEUC-X-2019-042 *(pdf)*

safety assessment of paper-based FCM

- Paper based packaging materials can not be used without migration testing as various additives have been added to obtain better properties in the final product.
- According to European Union, the maximum limit of migration of all the substances from packaging materials into food is 60 mg/kg.
- Some of the major additive migrants from paper and paperboard are mineral oils, dyes (organic, inorganic and synthetic), phthalates, adipates and polyfluorinated substances.

Regulation for migration studies on paper and paper board packaging:

1. Indian Standards:

- Paper and board material shall be of uniform formation, thickness and substance.
- It shall be free from visible specks, grease marks, cuts, pinholes and other blemishes.
- manufacturing of containers for packing or storing the food products shall conform to either of the Indian Standards specifications as provided below:

SI. No	List of Standards
1.	Grease proof paper – IS 6622
2.	Vegetable parchment or Grease proof paper or Aluminium Foil Laminate – IS 7161
3.	Aluminium Foil Laminates for Packaging – IS 8970
4.	General purpose packing or wrapping Paper – IS 6615
5.	Folding Box Board, uncoated – IS 1776
6.	Corrugated Fibre Board Boxes- Specification (Part 1) – IS 2771

safety assessment of paper-based FCM

2. U.S FOOD & DRUG ADMINISTRATION

a. US FDA 21 CFR 176. 170: Components of paper and paper board are used in contact with aquaeous and fatty foods.

example:

Substances identified in this section may be safely used as components of the uncoated or coated food-contact surface of paper and paperboard intended for use in producing, manufacturing, packaging, processing, preparing, treating, packing, transporting, or holding aqueous and fatty foods, subject to the provisions of this section.

b. US FDA 21 CFR 176.180: Components of paper and paper board are used in contact with dry foods

Substances generally recognized as safe for their intended use in paper and paperboard products used in food packaging

Example: dry fruits, spices, grains.

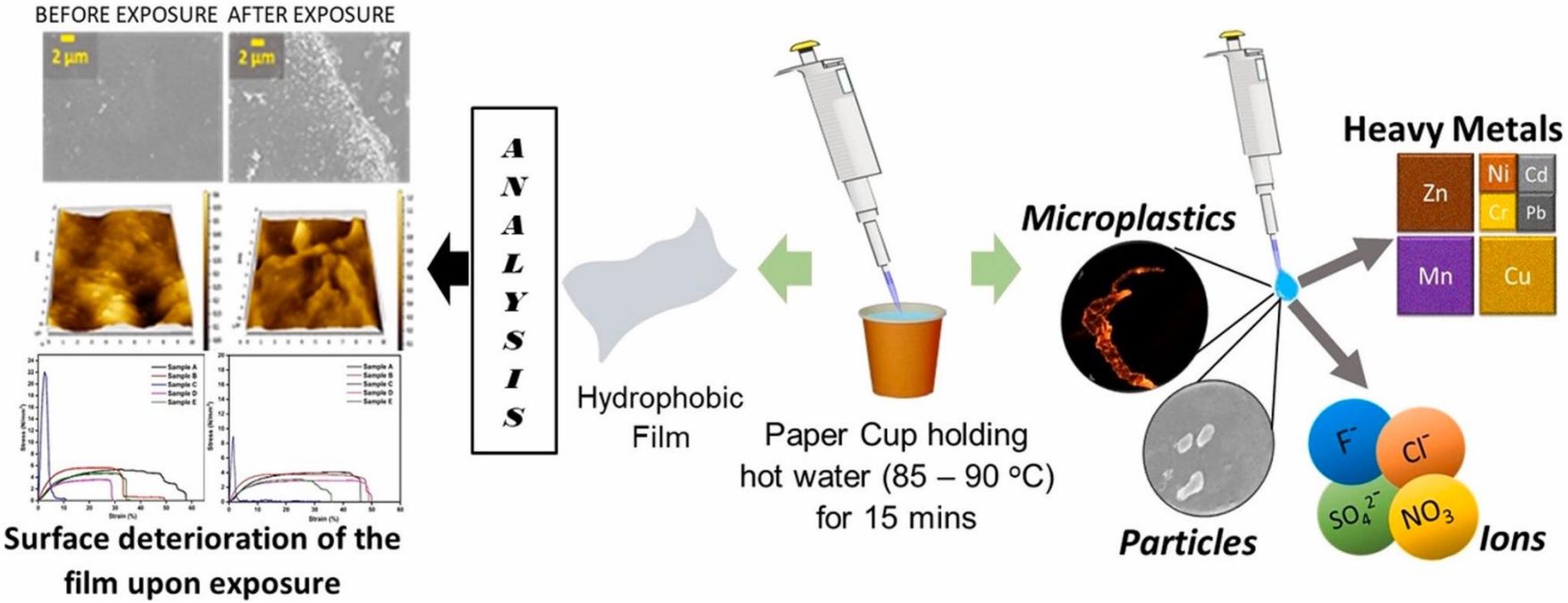
Specific migration limits for heavy metals as per EU 10/2011 and FSSAI- 2018 for PET

S.N	Heavy Metal	Specific Migration Limit (SML) (mg/kg) as per EU 10/2011	SML (mg/kg) as per FSSAI (Packaging) Regulations, 2018
1	Arsenic	0.04 mg /L <0.4 mg/kg of food or simulant	Not specified
2	Antimony	Not specified	Not specified
3	Barium	1 mg/kg	1 mg/kg (food or simulant)
4	Cadmium	Not specified	Not specified
5	Chromium	Not specified	Not specified
6	Cobalt	0.05 mg/kg	0.05 mg/ kg
7	Lead	Not specified	Not specified
8	Mercury	Not specified	Not specified
9	Selenium	Not specified	Not specified
10	Zinc	5.0	25

Short Term Food Applications

Case Study On Tea Cups

Microplastics and other harmful substances released from disposable paper cups into hot water

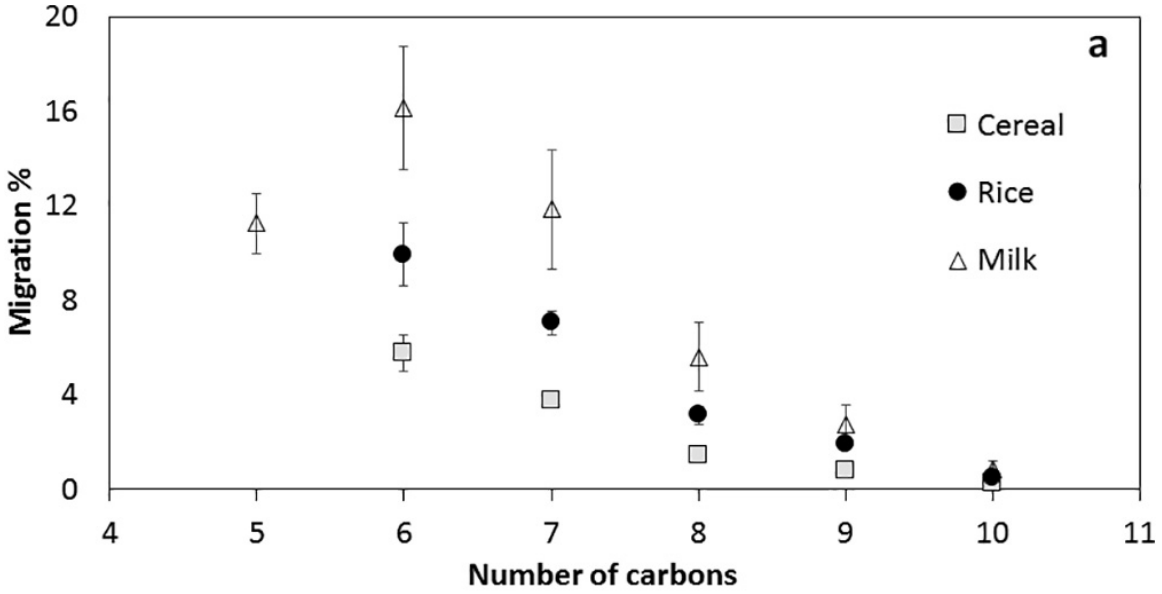


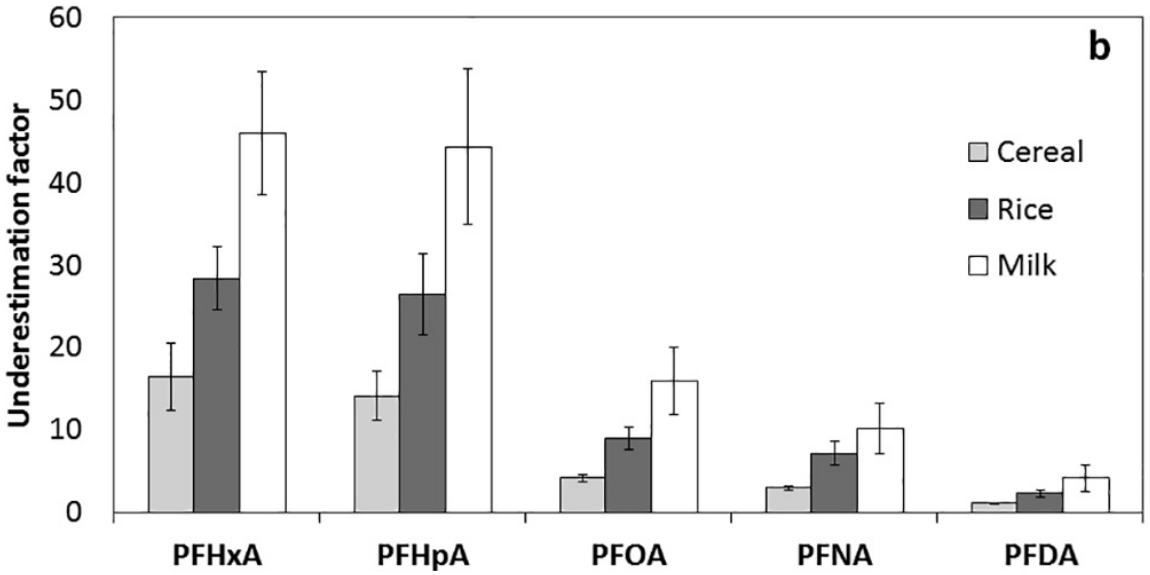
- 25,000 micron-sized microplastic particles into one cup of hot water in 15 min (100 ml)
- scanning electron micrographs indicate 102 + 21.1 × 10^6 sub-micron-sized particles/ml into the same volume of liquid.
- Toxic heavy metals like Pb, Cr, and Cd were detected in the films which can be transferred into hot water.

https://doi.org/10.1016/j.jhazmat.2020.124118

Long Term Food Applications

Occurrence of per- and polyfluorinated compounds in paper and board packaging materials and migration to food simulants and foodstuffs





a) Migration percentages of PFCAs to the foodstuffs as a function of the number of carbons

b) Underestimation factor of Tenax® for PFCAs migration into the foodstuffs.

Services offered by CSIR-CFTRI in Food Packaging

- Migration analysis of Plastic food packaging materials
- Global Migration Analysis as per BIS & USFDA methods
- Specific Migration Analysis as per EU 10/2011
- Overall migration analysis of Paper and paper board materials as per USFDA

HPLC

GC-MS

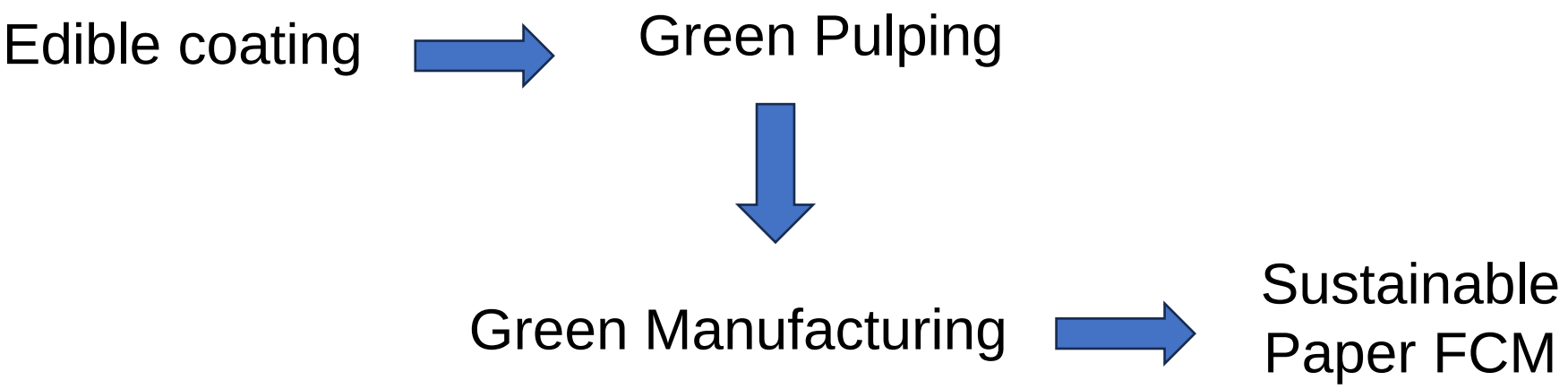
ICP-OES

Sustainable coatings and paper based packaging

- Bio-based coatings
- Biopolymers
- Bioplastic PLA, PBAT and PHAs
- Antimicrobial coatings
- Active packaging paper based packaging

Challenges

- Lack of Regulations for migration analysis

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