SAFETY OF RECYCLED PAPERBOARD:
MINERAL OIL CONTENT DETERMINATION,
MIGRATION TO FOOD,
AND CLEAN-UP STRATEGIES

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OUTLINES

• MINERAL OIL IN PAPER-BASED FOOD PACKAGING

• EXTRACTIVE AND ANALYTICAL ISSUES

• “SHOPPING TROLLEY” CONTAMINATION SURVEY: RESULTS

• MIGRATION KINETICS FROM PACKAGING TO FOOD: RESULTS

• CLEAN-UP STRATEGIES: PRELIMINARY RESULTS
MINERAL OIL SOURCES:
ENVIRONMENT & FOOD

• ENVIRONMENT:
SMOG & INDUSTRIAL POLLUTION
TRAFFIC
PETROLEUM SPILLAGES
PESTICIDE FORMULATIONS
COSMETICS

• FOOD:
JUTE BAGS BATCHING OIL
BAKERY & SWEETS ANTISTICKING
DUST BINDING
FRUIT & DRIED FRUIT POLISHING
PAPER BASED FOOD PACKAGING

Hydrocarbons are the most abundant xenobiotics in our body (~ 1 g)
(Concin et al., Mineral oil paraffins in human body fat and milk, 2007)
PAPER-BASED PACKAGING DESTINATION

Source: Istituto Italiano Imballaggio, report 2010 on 2009 data
THE ISSUE OF MINERAL OIL IN PAPER BASED PACKAGING FOR FOOD CONTACT

• LACK OF TOXICOLOGICAL DATA ON HYDROCARBONS

• LACK OF RELIABLE ANALITICAL TEST FOR MINERAL OIL CONTENT

• LACK OF REGULATORY INTERVENTION

NEED OF A DOMINO EFFECT!
**PAPERBOARD EXTRACTION OPTIMIZATION: RESULTS**

**Solvent:** Ethanol ideal for low MW & to swell fibres, hexane ideal for medium-high MW

**T & time:** high T & prolonged contact time extract more hydrocarbons but also more undesired compounds

**Ideal:** Ethanol:hexane = 50:50, 2h at RT

**Other extracted:** DIPN (“recycling markers”) & phthalates
FOOD EXTRACTION OPTIMIZATION: RESULTS

**Superficial** contamination:
from packaging → hexane is IDEAL

**Deep** contamination:
pre-packaging → hexane inadequate

To evaluate deep contamination → preparation of spiked “handmade pasta”:

- **just grounded**
- suspended in hexane 3 h at RT
- suspended in polar solvent 3 h at RT
INSTRUMENTAL ANALYSIS:
on line coupled normal phase HPLC-GC/FID

- Applicable to high lipid content (up to 20%) samples
- Columns & precolumns (retention gap technique): home-made
- LC isolation of fractions of interest → sent to GC
- FID ideal: high linearity range & same RF for all hydrocarbons
MINERAL OIL MIGRATING FRACTION

MOSH < nC24 CONTAMINATION:
RESULTS

FRESH FIBRES

RECYCLED FIBRES

OPTIONAL SAFETY LIMIT: 4 ppm IN BOARD → < 0.6 ppm IN FOOD
MINERAL OIL MIGRATION KINETICS: RESULTS

CONTROLLED MIGRATION PLAN on

- without internal barrier
- with internal barrier

WAS INVESTIGATED AS A FUNCTION OF
- storage conditions (T, time, position)
- presence of internal bag
- presence of external carton board box

MINERAL OIL CONTENT IN MUESLI UNDER DIFFERENT STORAGE CONDITIONS

IN BOXED PACKS, MIGRATION CONTINUES UP TO END OF SHELF LIFE (ca. 1 year) REACHING HIGH CONTAMINATION LEVELS
“SPONGE EFFECT” of POLYOLEPHINIC BARRIER

MOSH MIGRATE FROM PAPERBOARD (BLACK) TO PLASTIC (PINK) AND THEN TO MUESLI (BLUE) STORED AT 60°C: PLASTIC BETWEEN PAPERBOARD AND FOOD ACTS AS A STORAGE LAYER FOR CONTAMINANTS.
MINERAL OIL FRACTION SHIFTING UNDER ACCELERATED MIGRATION

- HIGHER MW HYDROCARBONS SIGNIFICANTLY MIGRATE ONLY AT HIGH TEMPERATURES
- ACCELERATED MIGRATION OVERESTIMATES AND MISREPRESENTS THE REAL MIGRATION PATTERN
PULP CLEAN-UP STRATEGIES

REDUCTION OF THE MINERAL OIL CONTENT OF RECYCLED PAPER BY USING ADDITIVES WITH HIGH AFFINITY TO HYDROCARBONS (& OTHER POLLUTANTS)
THE ADDITIVES ARE RECOVERABLE AND RECYCLEABLE
Thank You

Mahalo

Kiitos

Toda

Obrigado

Merci

Gracias