# Development of packaging factors in seafood production following the Food Contact Material legislations

# Tendenze di sviluppo del packaging ittico anche alla luce della normativa MOCA


Marco Dalla Rosa*, Santina Romani**

*Food Technology Degree Course Coordinator
** Professor of Food Packaging
Alma Mater Studiorum - Università di Bologna
Campus of Food Science
Piazza Goidanich 60
47521 CESENA (ITA)


ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
CAMPUS DI CESENA

AQUAFARM

# Packaging dei prodotti ittici - seafood packaging

Shelf-life extension is the keyword for fresh or minimally processed fish and seafoods

**Most popular**

- Modified atmosphere packaging (MAP)
- Vacuum-packaging(VP)

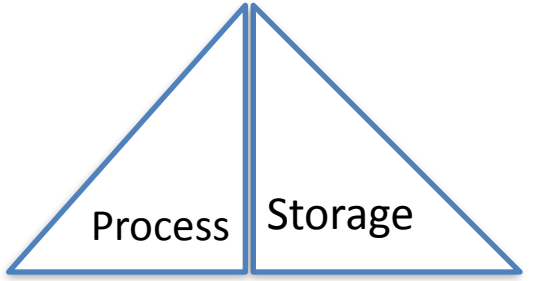
Factors

- Raw and packaging materials,
- temperature
- gas mixtures

Packaging Materials

Processing and storage Packaging for canned fish

Longer Shelf-life




## MAP factors and evolution

### Advantages

- The storage life can be extended.
- The appearance of the pack is attractive and the transparent packaging is not in close contact with the contents
- Modified atmosphere packs are odourless, easy to label and convenient to handle.
- In addition they are leakproof and robust.

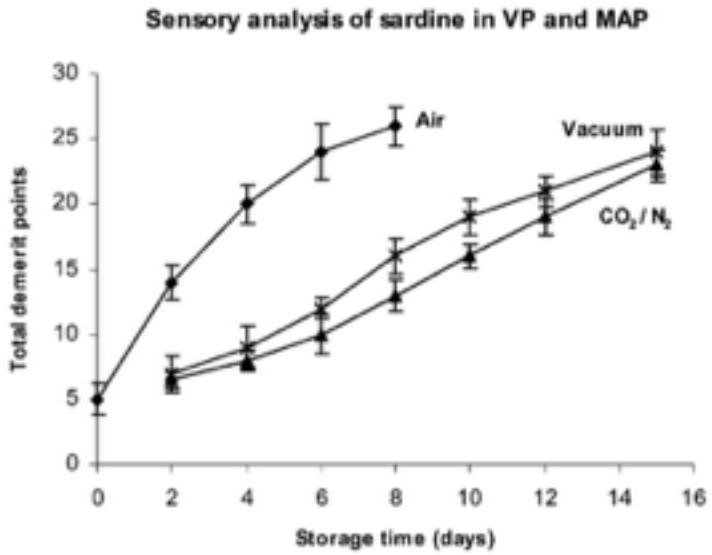
### Disadvantages

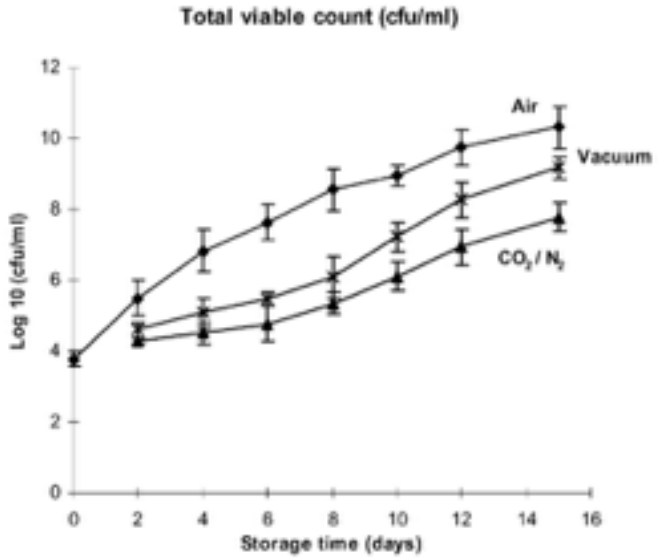
- Modified atmosphere packing is relatively expensive,
- Continuous production needs expensive packaging machinery.
- The walls of a pack may collapse when the enclosed atmosphere contains a high proportion of carbon dioxide
- The problem can be avoided by correct choice of gas mixture.

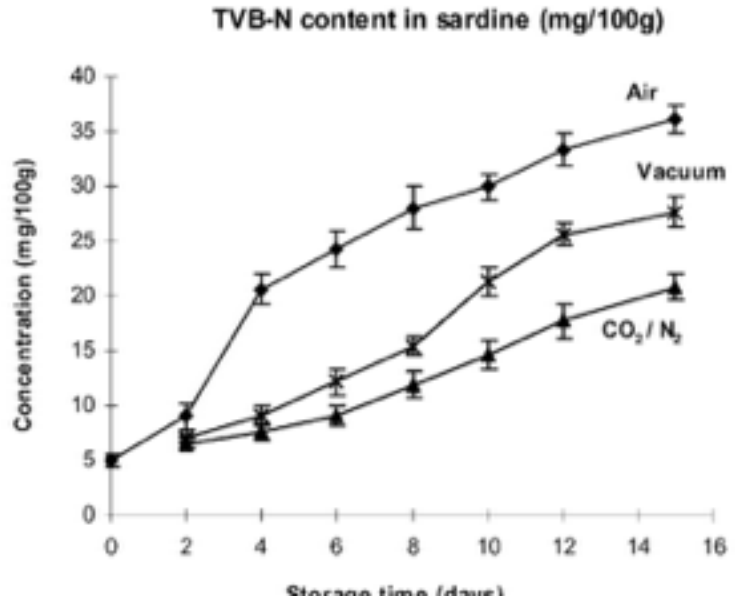
The packs must be kept at or close to 0°C throughout distribution if the full benefits of a modified atmosphere are to be maintained.

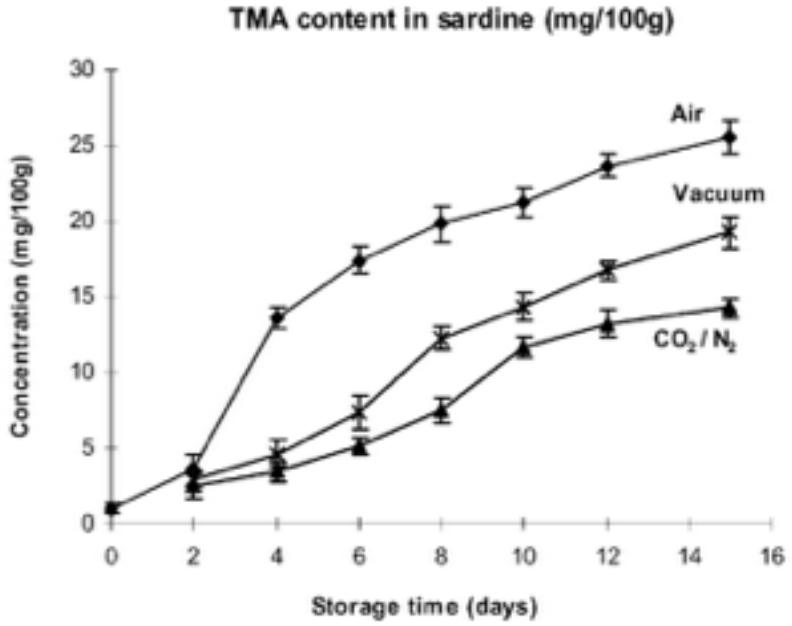
(FAO ORG)

# MAP *vs.* VP




MAP: 60% $CO_2$ and 40% $N_2$,

typical for packing fatty fish in MAP

Ozogul et al.,

Food Chemistry 85 (2004) 49–57

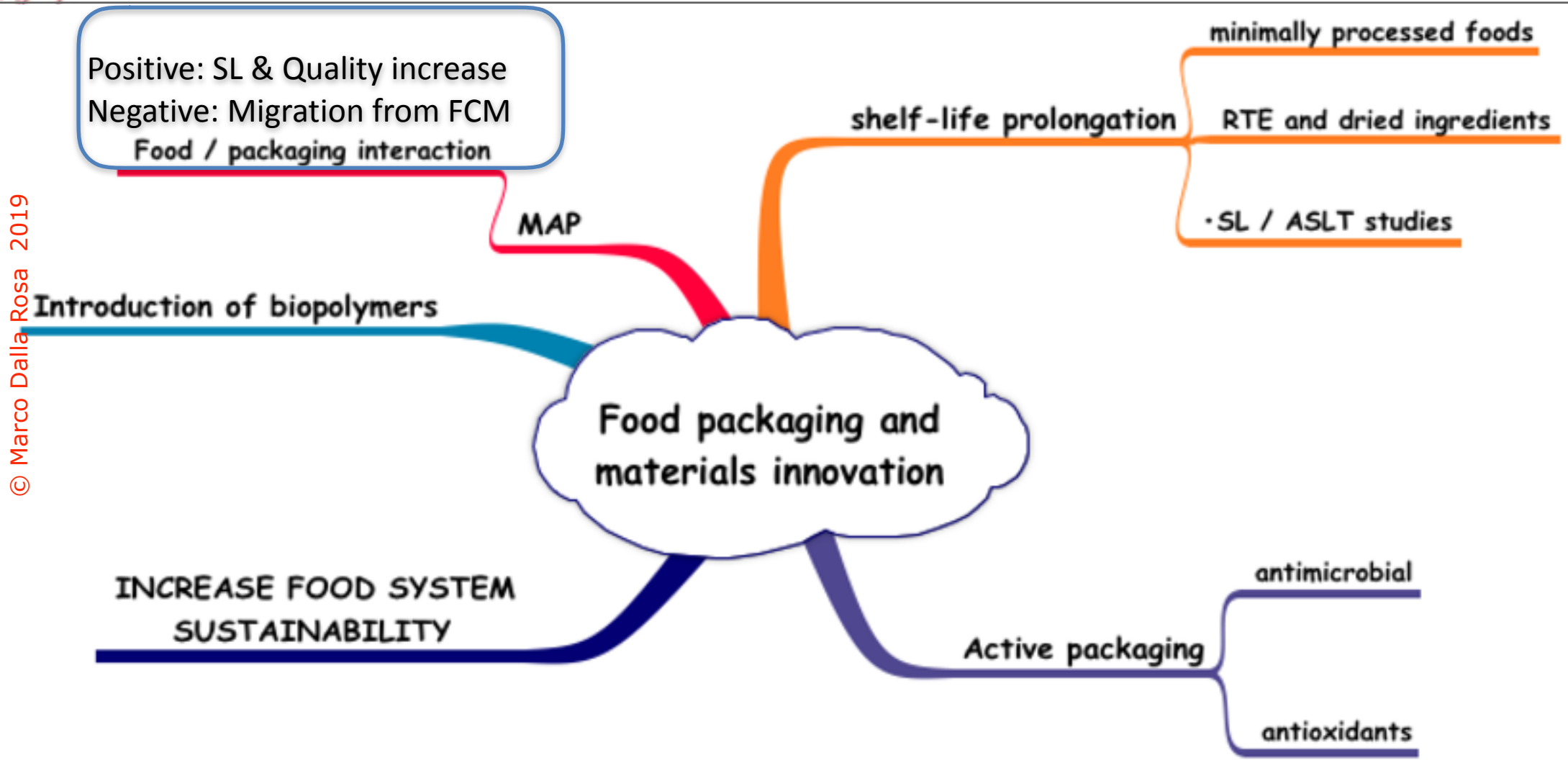
white fish, scampi, shrimp and scallops 40% $CO_2$, 30% $O_2$, 30 % $N_2$

salmon, trout, fatty fish such as herring and mackerel, and for smoked fish products 60% $CO_2$ and 40% $N_2$

## Food packaging innovation and optimization @UNIBO

- shelf-life prolongation of minimally processed foods, RTE and dried ingredients, SL / ASLT studies
- MAP, food / packaging interaction
- introduction of biopolymers
- active packaging to improve antimicrobial, antioxidants properties
- intelligent / smart packaging to improve traceability and product informations

# Packaging and Sustainability



# Argon and Nitrous oxide ($N_2O$) MAP

Contents lists available at ScienceDirect

Food Research International

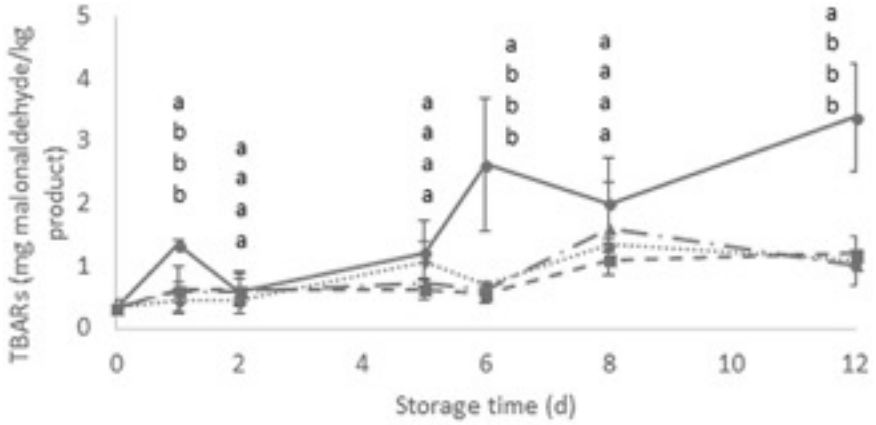
journal homepage: www.elsevier.com/locate/foodres

The impact of gas mixtures of Argon and Nitrous oxide ($N_2O$) on quality parameters of sardine (*Sardina pilchardus*) fillets during refrigerated storage

Ana Cristina De Aguiar Saldanha Pinheiro[a], Eleonora Urbinati[a], Silvia Tappi[b,*], Gianfranco Picone[a], Francesca Patrignani[a,b], Rosalba Lanciotti[a,b], Santina Romani[a,b], Pietro Rocculi[a,b]

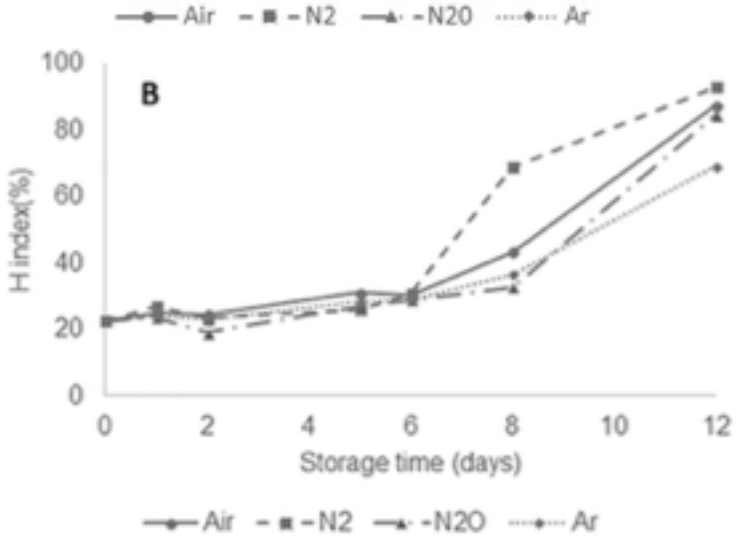
Ar and $N_2O$ lowest level of
Total mesophilic bacteria
Total psychrotrophic bacteria

Product stored in argon was also characterized by the lowest level of total coliforms




## TBARs

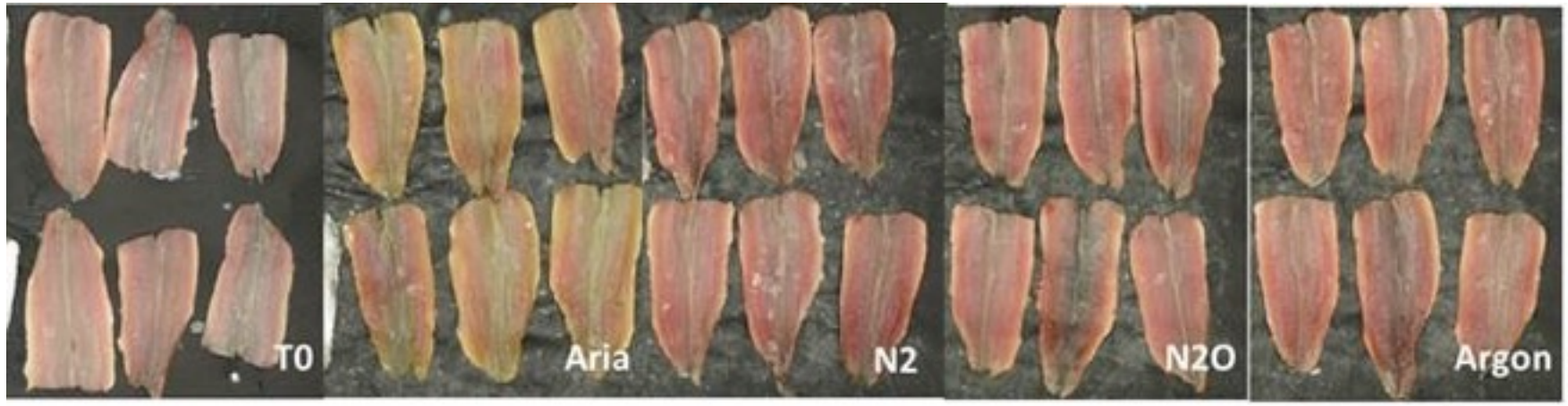
- GOOD QUALITY:5 mg malonaldehyde/kg,
- The fish may be consumed up to a level of 8 mg MA/kg in TBARS value




## H Index

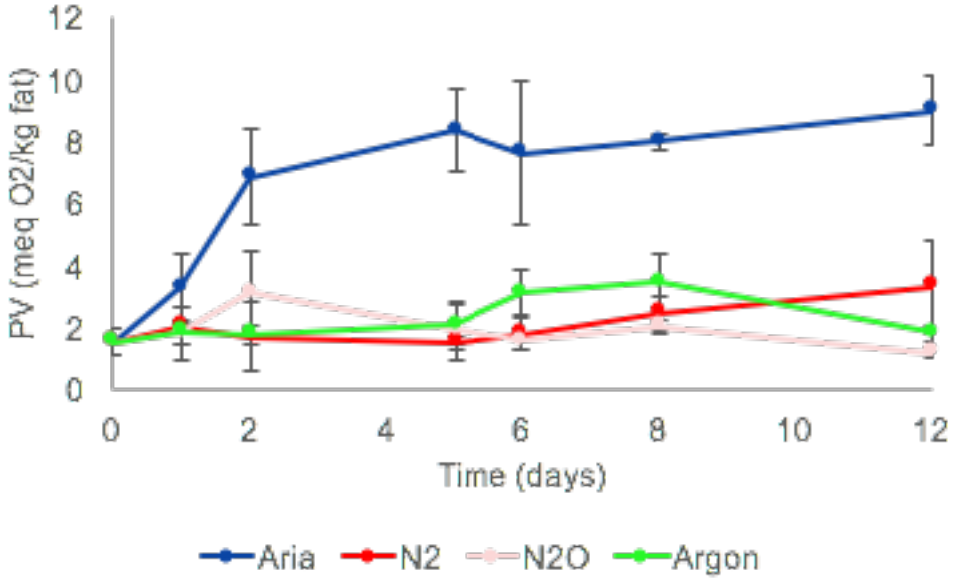
*H index* (%) = (*Hx*)/(*IMP* + *Ino* + *Hx*) ∗ 100

TMAO, TMA, Inosine, AMP, Hypoxanthine, ATP, ADP, IMP by HR-NMR




Colour was affected by MAP and resulted in higher L* and lower a* values in Air sample

Fat oxidation was inhibited by MAP as shown by PV values.




Tappi et al., 2018, FoodOmics Conference, Cesena (ITA)

# Active Packaging

CIRI ADVANCED APPLICATIONS IN MECHANICAL ENGINEERING AND MATERIALS TECHNOLOGY

CIRI AGRIFOOD

## ROADMAP from laboratory to industry

ILAPAK

IMA GIMA

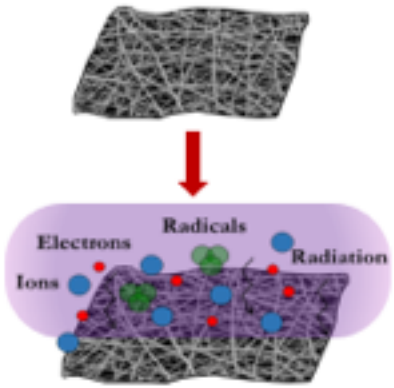

**LCA Analysis**

Barilla
The Italian Food Company. Since 1877.

**Multilayer production and characterization**

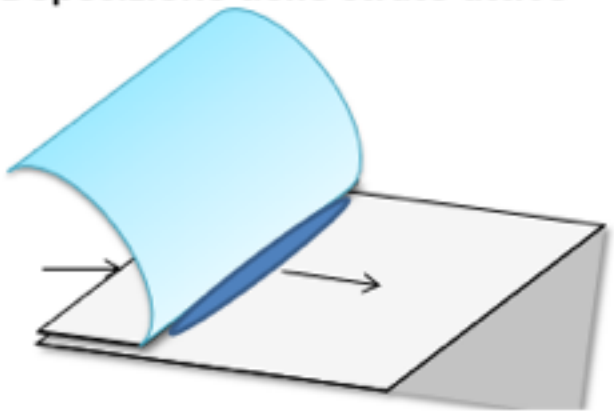
# Multi-layer assembly step

1. **Trattamento plasma**




Funzionalizzazione plasma a freddo del PLA

2. **Deposizione dello strato attivo**



Deposizione manuale a lama del gel attivo

3. **Accoppiamento e saldatura del multistrato**

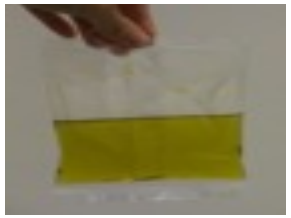
Termosaldatura laterale del multistrato

# Peroxide Values

## Sample model systems (sunflower oil)

Multilayer shelf-life studies / Oxygen Scavenger

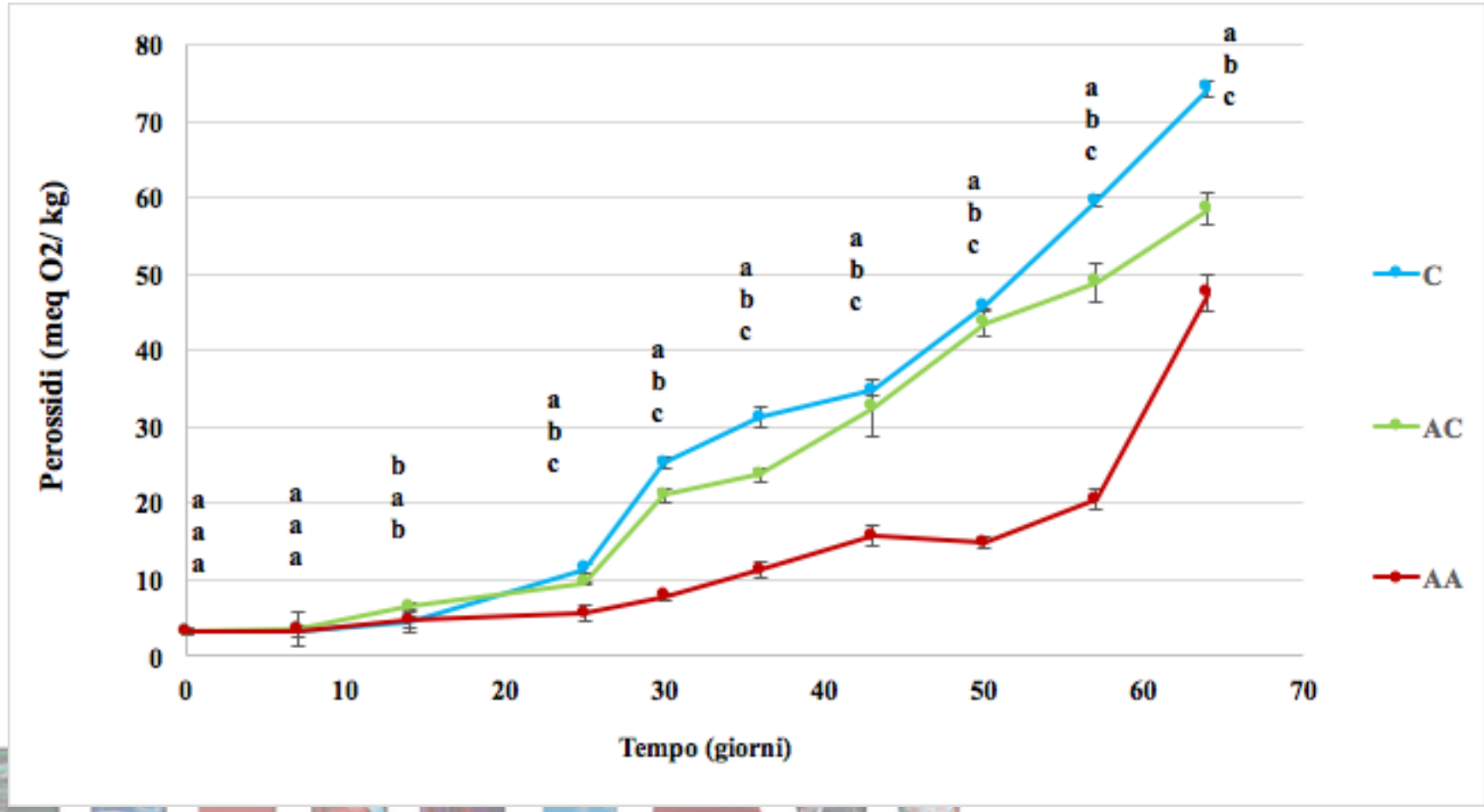
**Sample model systems (sunflower oil)**



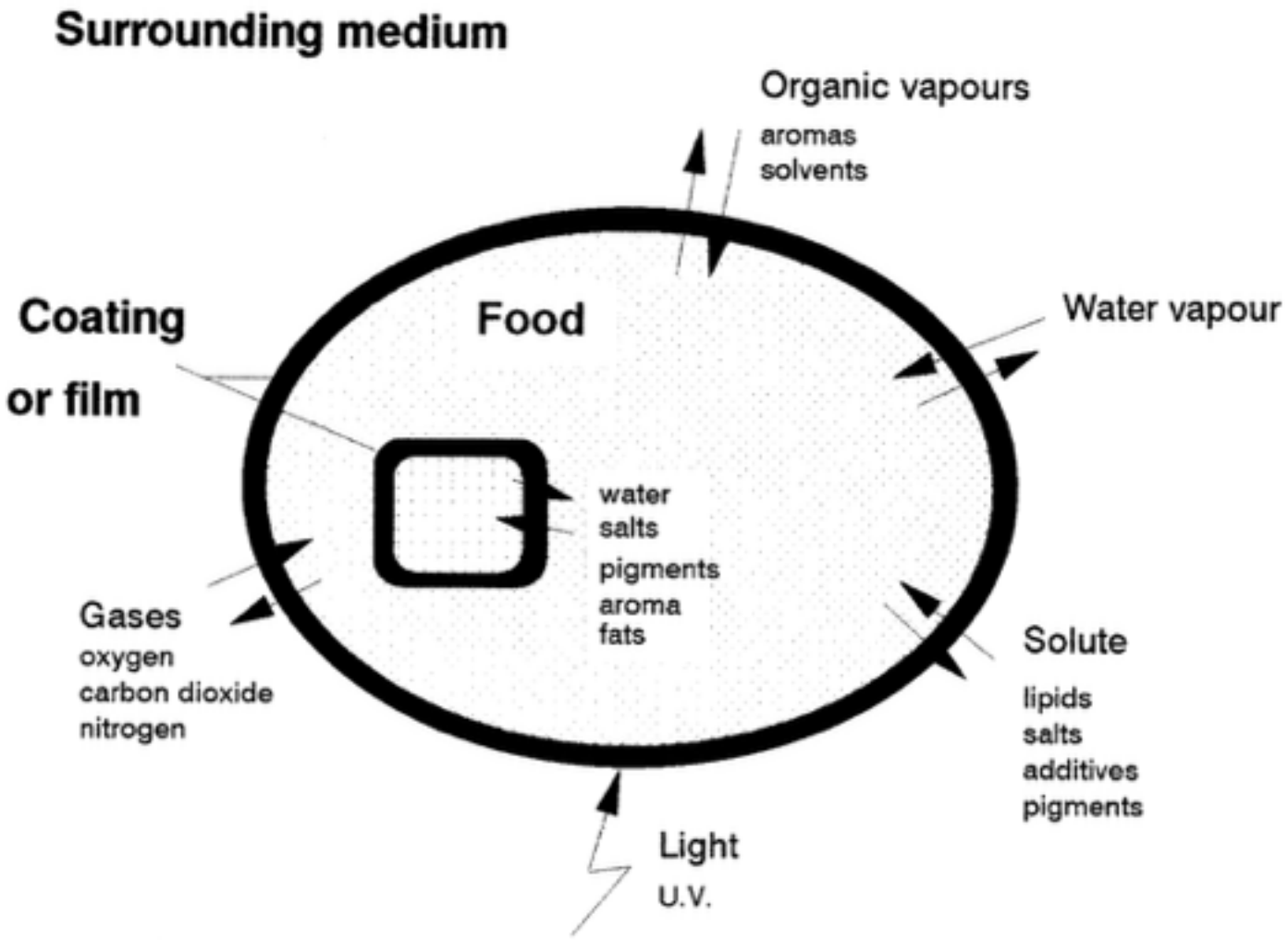
**Real systems samples (Condiments / ready sauces)**

Control

**Multilayer active film (Oxygen scavenger)**



# Packaging commestibile - Edible packaging: Tomorrow's Packagings ?




**Debeaufort** et al., 2010

## Experimental data on fish / seafood

- Carragenen coating to prevent superficial dehydration
- Carboxymethylcellulose, methylcellulose, hydroxypropylmethyl-cellulose to improve frying performance
- Mixture of hydrocolloids (alginates, gums, cellulose derivatives, etc.) and acids (lactic or acetic acids) or antimicrobial agents to reduces the growth of microorganisms such as *Listeria monocytogenes*

## Vacuum Packaging

Modified atmosphere packing is relatively expensive, currently about twice the cost of vacuum packing.

Shelf life extension 3-fold under VP (4-fold under MAP)

Vacuum Packaging is reliable when microbial growth could be slow by her factors as freezing or drying

Vacuum packaging better reduce the $O_2$ content but with a higher contact between seafood and packaging materials

# Food contact material issue

Global Harmonization Initiative
FOOD PACKAGING MATERIALS

**Food contact materials (FCMs) comprise mainly the following categories:**

- **food packaging and its accessories (e.g. caps, stoppers);**
- **promotional articles (e.g. toys, cards, labels) included into the primary package;**
- **equipment, devices, utensils and containers for the production/industrial manufacture, storage and packaging of food;**
- **equipment for the distribution and storage of drinking water;**
- **kitchenware, utensils and containers for the institutional/domestic preparation and consumption of food.**

**Composition:**
- **conventional plastic**
- **biodegradable plastic (sustainability)**
- **post-consumer recycled (PCR) plastic (circularity)**
- **active and intelligent materials (AIMs)**
- **nanomaterials (nanotechnology)**

**PET packaging for organic honey**

**Safety-by-design:**
- **Intentionally added substances (IAS) (monomers, additives, catalysts, etc.)**
- **Non-intentionally added substances (NIAS) (impurities, oligomers, reaction products, etc.)**
- **PCR materials (plastics, paper and board, etc.) (residual food, chemicals by misuse, printing inks, adhesives, etc.)**

**MIGRATION**

**(all must be risk - assessed)**

A. Ariosti, 2019

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# Food contact material issue

**Migrants from FCMs must not:**

**A. change the nutritional composition of food;**

**B. pose a risk to human health;**

**C. cause taints problems in food, with undesirable changes to their sensory characteristics.**

**DETERMINATION OF MIGRATION:**

**A. STANDARDIZED TESTS WITH FOOD SIMULANTS**

**B. PREDICTION BY MATHEMATICAL MODELS**

**C. CALCULATION OF POTENTIAL MIGRATION (ASSUMING 100% MIGRATION TO FOOD OF THE SUBSTANCE PRESENT IN THE FCM)**


SCIENTIFIC OPINION

**Scientific Opinion on safety assessment of the active substance, polyacrylic acid, sodium salt crosslinked, for use in active food contact materials[1]**

EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids (CEF)[2,3]

GHI
GLOBAL HARMONIZATION INITIATIVE

A. Ariosti, 2019

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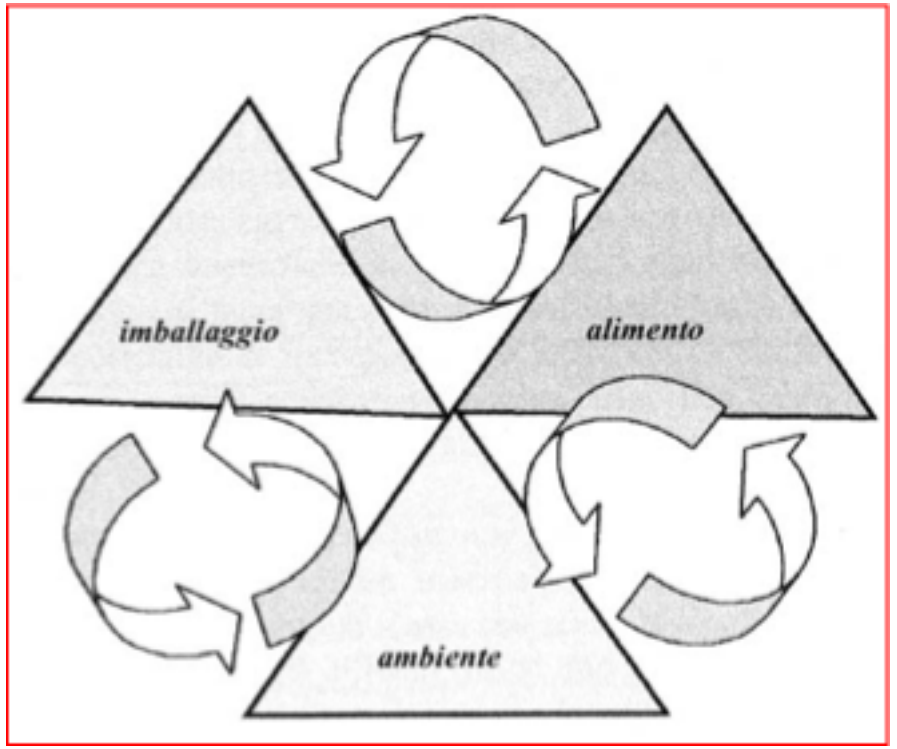
# Migrazione / Migration

**Definitions:**

- '**migration**' means the diffusion of substances from food contact material into the food, which can be of risk to human health or vice versa, which is important to the quality of the food
- "**permeation**" refers to the process where chemical substances diffuse, such as through a certain layer of a multilayer material or vice -versa

The migration process can be divided into four main steps:

- **1)** diffusion of chemical compounds through the polymers;
- **2)** desorption of the diffused molecules from the polymer surface;
- **3)** sorption of the compounds at the plastic–food interface; and
- **4)** desorption of the compounds in the food



# Migration / Migrazione: Types of interaction

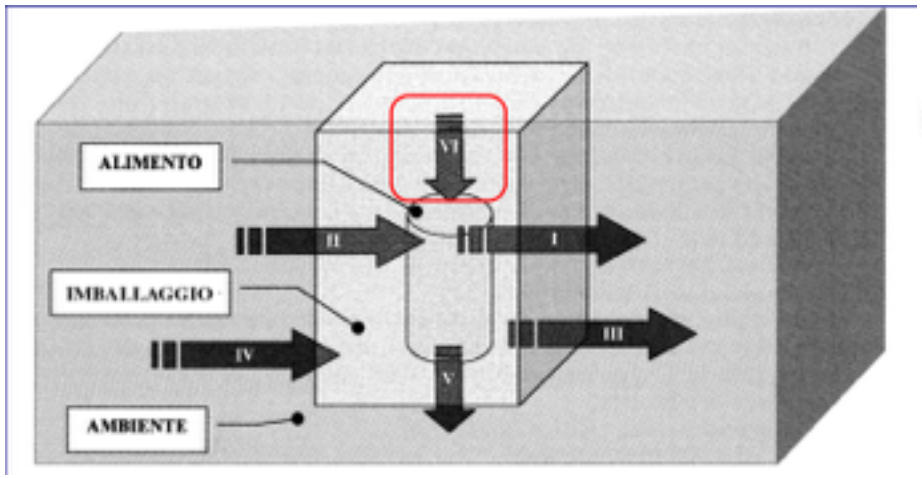
I. From food to environment (e.g. loss of aromas and volatiles)
II. From environment to food (e.g biological or chemical contamination)
III. From packaging to environment (waste disposal packaging)
IV. From environment to packaging (light, air, micro & macroorganisms)
V. From food to packaging (negative migration or scalping)
VI. From packaging to food: MIGRATION of compounds transfer

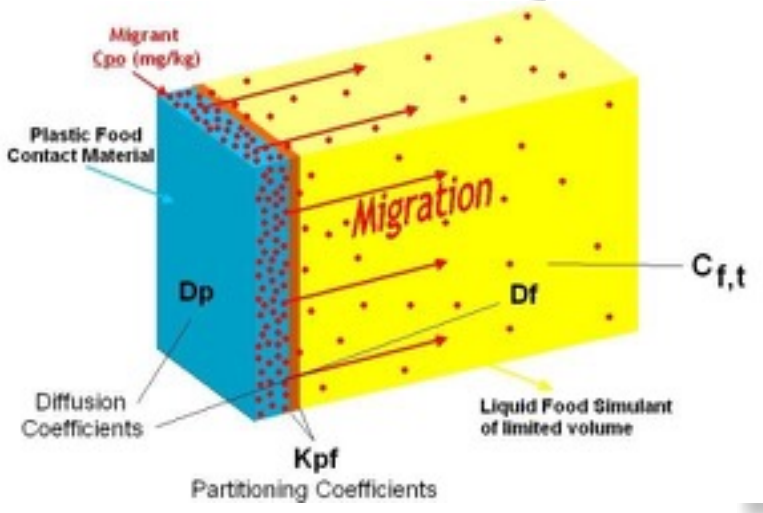
**EXPOSURE ASSESSMENT**

- EU Reg. (UE) n. 10/2011: migration from a 6 $dm^2$ cubic packaging where the substance under evaluation is present, to 1 kg of food consumed daily;*

- US-FDA: databases of consumption factors per type of food and material are used to calculate cumulative estimated daily intakes (CEDI).

(case by case evaluation of known substances for clearance and inclusion in positive lists or repositories)




* it is carried out in liquids simulating the extractive capacity of food, after conditions of contact (t, T - simulating reality) with the sample of material under examination.
* Fatty food often more extractive

# Adempimenti / Fulfillments

## BRC FOOD

3.5.1.1 L'azienda deve adottare una procedura documentata per la valutazione del rischio associato a ciascuna materia prima o a una certa categoria di materie prime, inclusi gli imballaggi primari, al fine di identificare i rischi potenziali per la sicurezza [...]

3.6.1
Le specifiche relative alle materie prime e agli imballaggi primari dovranno essere adeguate e dettagliate e conformi ai requisiti legali e di sicurezza pertinenti

3.9.1 La tracciabilità dovrà essere garantita tramite: identificazione delle materie prime, inclusi gli imballaggi primari

## IFS FOOD

4.5.2 Devono esistere **specifiche** dettagliate per tutti i materiali di confezionamento, conformi alla legislazione vigente pertinente.

4.5.3 Per tutto il materiale di confezionamento che potrebbe avere un'influenza sui prodotti, devono essere disponibili certificati di conformità rispondenti alla legislazione vigente.
Nell'eventualità non siano applicabili specifici requisiti legali, deve essere disponibile l'**evidenza** che dimostri che tali materiali di confezionamento siano adatti all'uso.

Questo vale per il materiale di confezionamento che potrebbe avere un'influenza sulle materie prime, prodotti semilavorati e prodotti finiti.

4.5.4 Sulla base dell'analisi dei pericoli e valutazione dei rischi associati, l'azienda deve verificare **l'idoneità del materiale** di confezionamento in riferimento a ogni prodotto interessato (per es. test organolettici, test relativi alla conservazione, analisi chimico fisiche, test di migrazione

# Adempimenti / Fulfillments

## LE NORME- REG. CE 1935/04 S.M.L.

**art. 16: dichiarazione di conformità alimentare** (già prevista dal DM 21.3.1973) ed allegato I

- dichiarazione scritta che attesti la loro idoneità al contatto alimentare e la conformità alle norme vigenti.

- deve essere resa disponibile alle autorità competenti che la richiedano

- deve accompagnare il MOCA in tutte le fasi dalla produzione alla vendita, ad esclusione della vendita al dettaglio, salvo che per i MOCA in ceramica, per cui la dichiarazione di conformità deve essere fornita anche alla vendita al dettaglio.

## REG. CE 1935/04 S.M.L.

Cosa deve contenere la dichiarazione di conformità:

1. identità ed indirizzo dell'**operatore** che produce o importa;
2. la **descrizione** della tipologia di **materiale**;
3. la **data** della dichiarazione;
4. la **dichiarazione** che i materiali rispettano le norme per la tutela della salute dei consumatori;
5. le specifiche relative alle **possibilità di impiego** (es. tempi e temperature).

da una sintesi della Dr.ssa S. Pironi, Parma 23-10-19

# Regime Sanzionatorio / Sanctioning regime: Reg. 1935/2004 Italian discipline on MOCA

**DECRETO LEGISLATIVO n. 29 del 10 febbraio 2017**

ART. 2 DLGS 29/2017 - VIOLAZIONE DEI REQUISITI GENERALI (da 1.500 a 80.000€)

ART. 3 DLGS 29/2017 - VIOLAZIONE DEGLI OBBLIGHI DI COMUNICAZIONE (da 10.000 a 30.000 €)

ART. 4 DLGS 29/2017 - VIOLAZIONE DEGLI OBBLIGHI IN MATERIA DI ETICHETTATURA (da 1.500 a 15k€)

ART. 5 DLGS 29/2017 - VIOLAZIONE DEGLI OBBLIGHI IN MATERIA DI RINTRACCIABILITA' (da 5.000 a 60k€)

ART. 6 DLGS 29/2017 - VIOLAZIONE DELLE NORME SULLE BUONE PRATICHE DI FABBRICAZIONE (1,5-40k€)

ART. 7 DLGS 29/2017 - VIOLAZIONE DEI REQUISITI SPECIALI PER MATERIALI E OGGETTI ATTIVI E INTELLIGENTI (da 4.000 a 40.000 €)

ART. 8 DLGS 29/2017 - VIOLAZIONE DELLE MISURE SPECIFICHE RIGUARDANTI I MATERIALI E GLI OGGETTI DI PLASTICA (da 1.500 a 60.000 €)

ART. 9 DLGS 29/2017 - VIOLAZIONE DELLE MISURE SPECIFICHE RIGUARDANTI I MATERIALI E OGGETTI IN PLASTICA RICICLATA (da 3.000 a 60.000 €)

ART. 10 DLGS 29/2017 - VIOLAZIONE DI OBBLIGHI RIGUARDANTI LA RESTRIZIONE ALL'USO DI ALCUNI DERIVATI EPOSSIDICI (da 5.000 a 60.000 €)

# Regime Sanzionatorio / Sanctioning regime: DL 29 / 2017 Italian discipline on MOCA

**VIOLAZIONI DI LIEVE ENTITÀ / MINOR VIOLATIONS**

Modalità della condotta

Esiguità del danno o del pericolo

Diffida

- **Regolarizzare le violazioni**
- **Prescrizioni da ottemperare entro un termine stabilito dall'autorità**

## SANZIONI DI NATURA PENALE / CRIMINAL PENALTIES

**Art. 440 c.p.** - Adulterazione o contraffazione di sostanze alimentari (reclusione da 3 a 10 anni)

**Art. 441 c.p.** - Adulterazione o contraffazione di altre cose in danno della pubblica salute (reclusione da 1 a 5 anni)

**Art. 444 c.p.** – Commercio di sostanze alimentari nocive (reclusione da 6 mesi a 3 anni). Colposo art. 452 c.p. (pena ridotta da 1/3 a 1/6).

**Art. 515 c.p.** – Frode nell'esercizio del commercio (reclusione fino a 2 anni o multa fino a € 2.065)

**Art. 5 lett. d) e 6 L. 283/1962** (arresto da 3 mesi a un anno o ammenda da € 2.582 a € 46.481

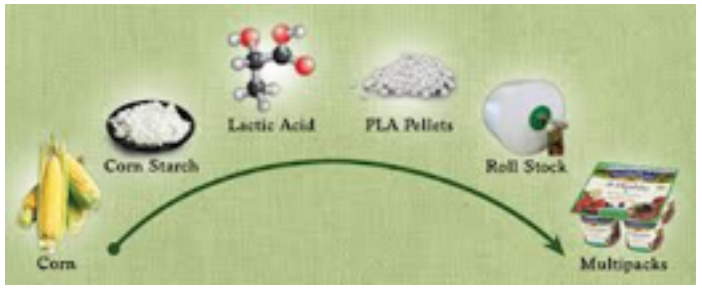
da una sintesi dell'Avv. G. Forte, Parma 23-10-19

# Trends in Global Food Packaging Regulation (Baughan, 2015)

- ☑ Trend 1: more restrictive requirements for materials used in contact with foods consumed by sensitive populations
  - *(e.g. Infant & children, BPA restriction, etc. )*
- ☑ Trend 2: more focus on novel materials and how to regulate them
  - *(e.g. nanomaterials, active compounds, etc.)*
- ☑ Trend 3: more attention to "chemicals of concern"
  - *(e.g. BPA, phthalates, azelates, citrates, mineral oil hydrocarbons, etc.)*
- ☑ Trend 4: more recycled food packaging
  - *(Recycled plastic, recycled paper/paperboard, Heightened interest in environmental issues is pressuring food manufacturers to consider using more recycled materials in food packaging; such materials comply with the legal requirements pertaining to their safe use and need a suitable purity for their intended use (G.G.M., Partner, PackagingLaw.com)*

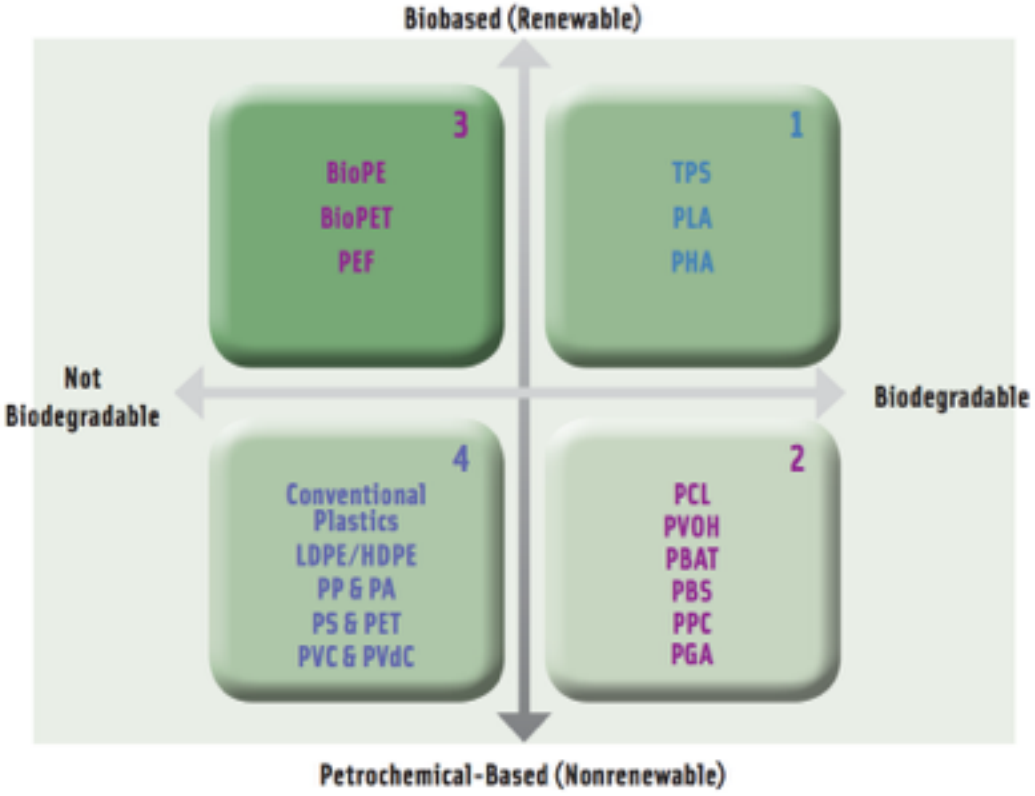
# Biobased and biodegradable Food Packaging Materials

## Biodegradation *vs*. Recycling




Converting a solid material into a gas via composting or biodegradation should only be a last resort.

It would be much better to capture the embodied energy and material for reuse through recycling




ROBERTSON, Food Technology, 06.14

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**GRAZIE PER L'ATTENZIONE / THANK YOU VERY MUCH**

Marco Dalla Rosa, Santina Romani

Alma Mater Studiorum - Università di Bologna - Campus of Food Science
Interdepartmental Research of Agrifood Industrial Research
Department of Agriculture and Food Sciences
Piazza Goidanich 60
47521 CESENA (ITA)

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