NEW PACKAGING TECHNOLOGIES-FOOD SAFETY & QUALITY

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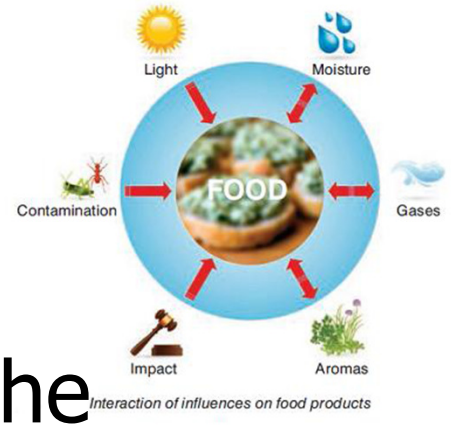
Packaging

- Packaging is a means of ensuring the safe delivery of a product to the ultimate consumer in sound condition, at the minimum *overall* cost.
- Packaging must protect what it sales, & sell what it protects.

Packaging - a very vital role in modern world

- Concern for health, requiring prevention of adulteration & providing hygienic products
- Movement of goods within & across countries from place of production to place of utilization
- in short, packaging - Protection, Preservation & Promotion
- Urbanization, improved living standard & higher disposable income – more demand for good Packaging
- In India the Packaging sector - growing @ 15 %
- Major user is Food Industry

Active Packaging



Interaction of influences on food products

- Active packaging System where the product, package and environment interact in positive way to extend the Shelf-life
- Packaging system that is capable of carrying out intelligent functions:
- 1) Extend: Prolong the shelf life of food products
- 2) Interact: Give consumers more product quality information

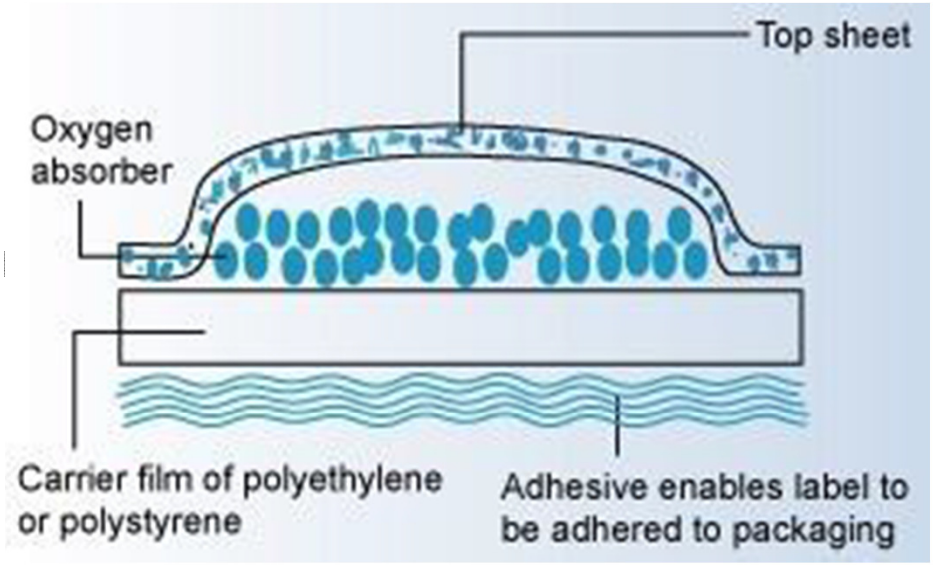
Active packaging

- **Microbial contamination -the shelf life of foods & increases the risk of food borne illness**
- AP: Packaging that **changes the condition of the packed food to extend the shelf-life or/and to improve safety or sensory properties, while maintaining the quality of the food**
- All AP technologies involve some **physical, chemical, or biological action for altering the interactions between the package, the product, and the package headspace to achieve desired outcome**

Active packaging systems

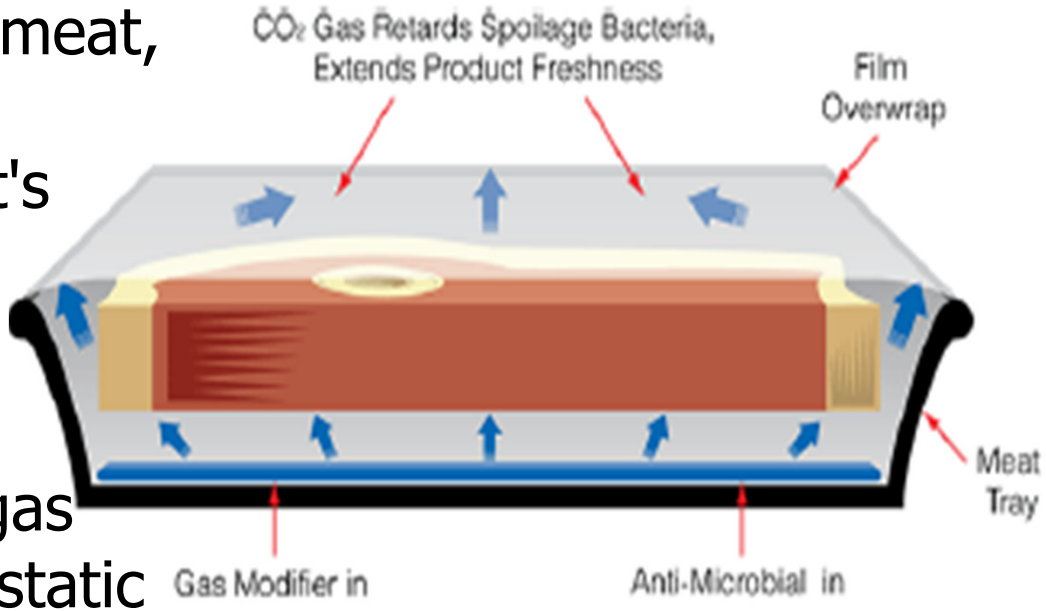
- MAP - substitutes the air inside a package with a correct gas mix for optimum quality and shelf life
- Gas Absorbers (sachets/pads/film) - capture residual gases such as O_2 and ethylene from inside the package
- Gas Generators (sachets/pads/film) - ethanol and CO2 emitters can be used as active features in order to address the weak points in the shelf life of packed goods
- Antimicrobial compounds: Spices & essential oils, organic acids, organic & inorganic salts, nano-compounds, enzymes, bacteriocins…

ETHYLENE ABSORBERS

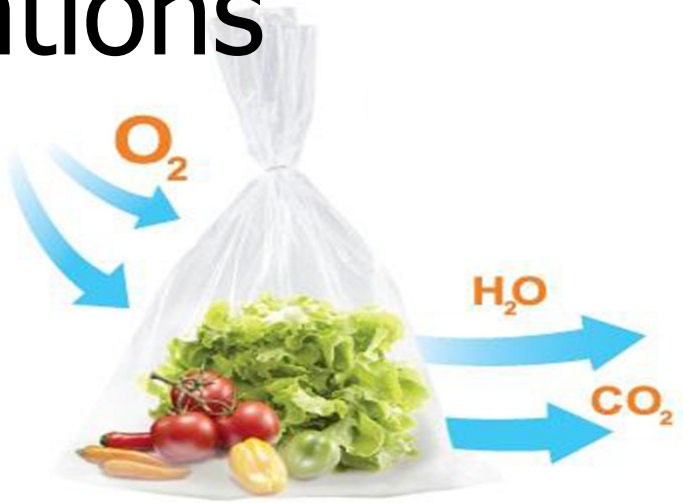


CO2 EMITTERS

- To extend freshness of meat, poultry and fish by maintaining the product's sensory features: color, texture and smell.
- Includes additives that produce CO2, an inert gas known to have bacteriostatic properties.
- CO2 gas helps retard the growth of spoilage bacteria present on the surface of the food.



Active Packaging Concepts & Innovations



Antimicrobial Technology

- a silver-based additive introduced into any plastic, paper, textile, paint or coating product.
- reduced the amount of moisture lost and thereby increasing the shelf-life without using additional food preservatives

Smart / Intelligent packaging

- Systems that monitor the condition of the packaged food to give information about the quality during transport and distribution
- Enhance food safety and bio-security
- The uniqueness of IP is in its ability to communicate: the package is the food's best companion and is in the best position to communicate the conditions of the food.

Applications

1. Tamper evidence: Breach of pack containment
2. Quality and safety indicators: (TTIs) - microbial growth - gas sensing devices - pathogen detection
3. Traceability devices: Radio frequency identification (RFID) chips/tags
4. Product authenticity: RFID - holographic images, logos

Time Temperature Indicators (TTI)

Temperature variations can lead to changes in product safety and quality.

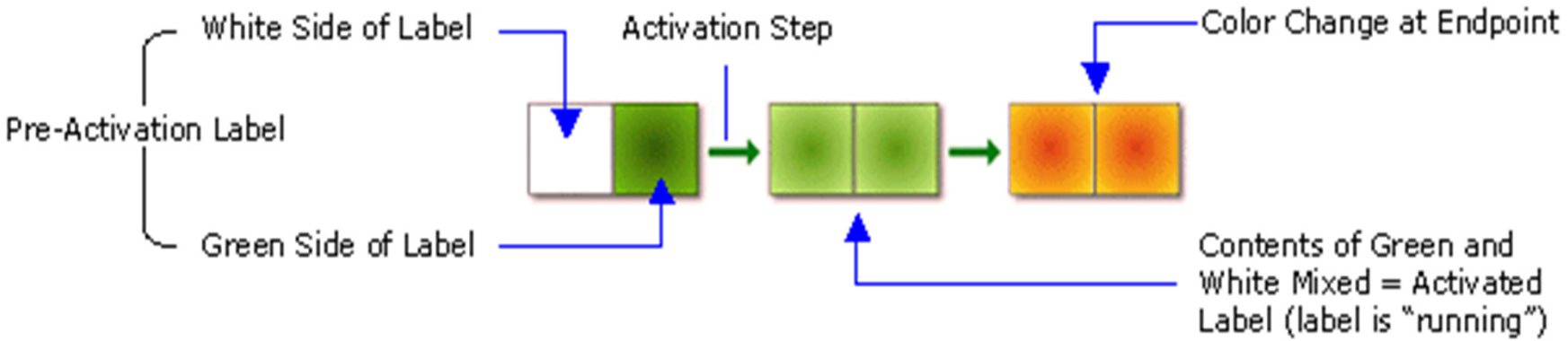
- TTIs are used as cost-effective and user-friendly devices to monitor, record, and translate the overall effect of temperature history on food quality in the supply chain
- Principle of TTI operation: mechanical, chemical, enzymatic or microbiological irreversible change, usually expressed as a visible response in the form of a mechanical deformation, colour development or colour movement

Freshness Detector

- Made to test the different levels of ammonia that the meat contains.
- Different types of meats emit a source of ammonia that can determine the expiration or spoilage.
- The sticker changes its color as more ammonia releases the meat.
- When the meat is completely expired, the bar-code on the package label would completely disappear and the cashier would not be able to ring up the item

Enzymatic TTIS

- Warn abusive conditions that might lead to growth of pathogens like E. coli within the product
- Based on a colour change induced by a drop in pH resulting from the controlled enzymatic hydrolysis of a lipid substrate



Labels

- A self-adhesive device that is specifically formulated to match the shelf life of the food products to which it is affixed
- As the active center is exposed to temperature over time it gradually changes color to show the freshness of the food product
- Fresh-Check is based on a solid state polymerization reaction, resulting in a highly coloured polymer.

Biosensor

- Biosensors are compact analytical devices that detect, record and transmit information pertaining to biological reactions
- A specific-pathogen antibody is attached to a membrane-forming part of the barcode.
- The presence of contaminating bacteria will cause the formation of a localized dark bar, rendering the barcode unreadable upon scanning

RFID

- RFID (Radio frequency identification) uses tags affixed to assets (food product, containers, pallets, etc.) to transmit accurate, real-time information to a user's information system.
- RFID benefits to the food industry: traceability, inventory management, labour saving costs, security and promotion of quality and safety
- RFID tag may also be integrated with a TTI or a biosensor to carry time-temperature history and microbiological data
- RFID tags can be printed on packaging like bar codes.

New Packaging Developments

- Metal can - continuous annealing, double cold reduction, beading, Improvement in coating and lacquering coated, differentially coated, easy to open open ends
- Glass - light weight & PE coated
- Canning to aseptic system to irradiation
- Metal & Glass to Plastic (Satnd up pouches/ Retort pouches)

Criteria for Packaging Selection for Food Safety

- Design Consideration
- Functional and Graphical
- Functional: Barrier Properties (WVTR/OTR/GTR), Strength
- Legal Requirements: Labeling, W&M, Nut Labeling, Font size
- Food Safety: Migration

Quality & Safety

- * Must be Relatively Simple
- * Must also be capable of being carried out Rapidly
- * Preferably they should give a Numerical results

Safety in Food Packaging

- Plastics are with wide range of properties to meet the most of the requirements of Food Packaging.

- In plastics besides basic polymers there are anti-oxidants, anti-blocking agents, anti-static agents, stabilizers, plasticizers, fillers, anti-slip agents and may also contain small amounts of monomers, oligomers, catalyst, polymerization residues etc.

- Basic polymers are high molecular weight, are inert and are unlikely to be transferred into foods.
- However, low molecular weight substances and additives are highly mobile and therefore likely to be transferred (migration) from the plastic packaging material into the food products with a possible Toxic Hazards.

Extractability / Migration Studies : Simulants for Determination of Overall Migrants – IS 9845

- A Distilled Water or water of equivalent quality
- B 3 % acetic acid (W/V) in aqua solution
- C^1 10% ethanol (V/V) in aqua solution
- C^2 50% ethanol (V/V) in aqua solution
- D n-heptane - shall be freshly distilled before use
- E Rectified Olive oil or mixture of synthetic triglycerides or sunflower oil

["E" suggested by EU for fatty foods need to be considered. However, methodology of estimation is not yet developed]

Classification of Foods and Selection of Simulants

I	Aqueous(pH>5) without fat	A	Honey, Water, Rasogolla etc.
II	Aqueous acidic without fat (pH $\leq$ 5)	B	Fruit Juices, Vinegar etc.
III	Alcoholic Beverages		
	i) Less than 10%	C^1	Beer etc.
	ii) Above 10%	C^2	Wine, Whisky etc.
IV	Oils, Fats, processed food with surface oil	D	Ghee, Vegetable Oil, Biscuits etc.

Simulating Solvents for different types of Food & Temperature – Time conditions

Conditioned of use	Type of Food	Water	3 % Acetic Acid	10 % Alcohol	50 % Alcohol	n-heptane
High Temp. (Retorting)	I, II, IV	121^0C 2 hrs	121^0C 2 hrs	-	-	66^0C 2 hrs
Hot filled $>66^0<100^0$	I, II, IV	100^0C 2 hrs	100^0C 2 hrs	-	-	49^0C for 30 min
Hot filled $< 66^0$C	I – IV	70^0C 2 hrs	70^0C 2 hrs	70^0C 2 hrs	70^0C 2 hrs	38^0C 30 min
Room Temp. no thermal treatment & frozen.	I – IV	40^0C 10 day	40^0C 10 day	40^0C 10 day	40^0C 10 day	38^0C 30 min

Limits of Migration
IS 9845

- In general limits of overall migration are specified as
  10 mg / dm^2 or / and 60 mg / liter
  Apart from overall migration of plastic in food simulant, there should not be any colour migration into the simulant apparent to the naked eye, even though the extractive value is within the limit
- Limits of specific migration of monomers of PVC, Polystyrene, Polyacrylonitrile, Nylon-6 are as under:

PVC	0.1 ppm
Polystyrene	0.2 ppm
Polyacrylonitrile	11 ppm
Nylon-6	10 ppm

PACKAGING FUTURE…

- In the near future the role of packaging will change, we will see packaging as a **resource rather than a resource waster**
- Keeping the molecule in play will gain momentum (**recyclability)**
- **Bio-based packaging materials will grow, but not necessarily biodegradable.**
- **Bright Future for Stand-Up Pouches: Standing for protection, Standing for communication, Standing for convenience, Standing for sustainability**
- Increasing health and environmental awareness, rising food prices and food safety concerns and improved purchasing power will drive growth in the **smart packaging market.**