ACTIVE PACKAGING

Tajnuba Sharmin

Lecturer

Dept. of Nutrition & Food Engineering

Daffodil International University

PACKAGING

- Packaging is the technology of enclosing or protecting products for distribution, storage, sale, and use
- Packaging maintains the benefits of food processing after the process is complete, enabling foods to travel safely for long distances from their point of origin and still be wholesome at the time of consumption.
- The primary purpose of food packaging is to protect the food against attack from oxygen, water vapour, ultraviolet light, and both chemical and microbiological contamination.

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Functions of Packaging

- product containment
- preservation and quality
- presentation and convenience
- protection during Distribution and Processing
- provide storage history

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ACTIVE PACKAGING

- What is the function of silica in the (shoes/ watch/ jewelry)?

ACTIVE PACKAGING

- Active packaging refers to the incorporation of certain additives into packaging film or within packaging containers with the aim of maintaining and extending product shelflife.

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USES

- to preserve the quality of food during the shelf life
- to increase the food safety
- to extend the shelf life of the product
- to decrease the food loss
- to reduce use of food additives
- as a marketing tool
- to develop new products

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TYPES OF ACTIVE PACKAGING

- Sachets and pads which are placed inside of packages, and active ingredients that are incorporated
- Directly into packaging materials.

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SACHETS AND PADS

- Kept inside the Packets

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SACHETS, LABELS, FILMS, COATINGS!!

Sachets

A small sealed bag or packet containing a small quantity of something.

Labels

A panel found on a package of **food** which contains a variety of information about the nutritional value of the **food** item.

Films

Packaging film can produce a tightly wrapped package and is particularly useful in unitizing smaller packages on pallets

Coatings

Coating in the **food** industry is the application of a layer of liquids or solids onto a product

DISADVANTAGES

- cannot be used in liquid foods.
- cannot be used in package made of flexible film, as the film will cling to the sachet and prevent it from performing its function.
- risk of accidental ingestion by consumers

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MATERIALS CONTAINING ACTIVE COMPONENTS

- incorporating the scavenger into the packaging material itself
- More efficient

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APPLICATIONS

1. Oxygen Scavengers
2. Carbon Dioxide Generating System
3. Ethylene Scavengers
4. Flavour and Odour Absorber/Releaser
5. Antioxidants
6. Humidity Control
7. Antimicrobial Packaging

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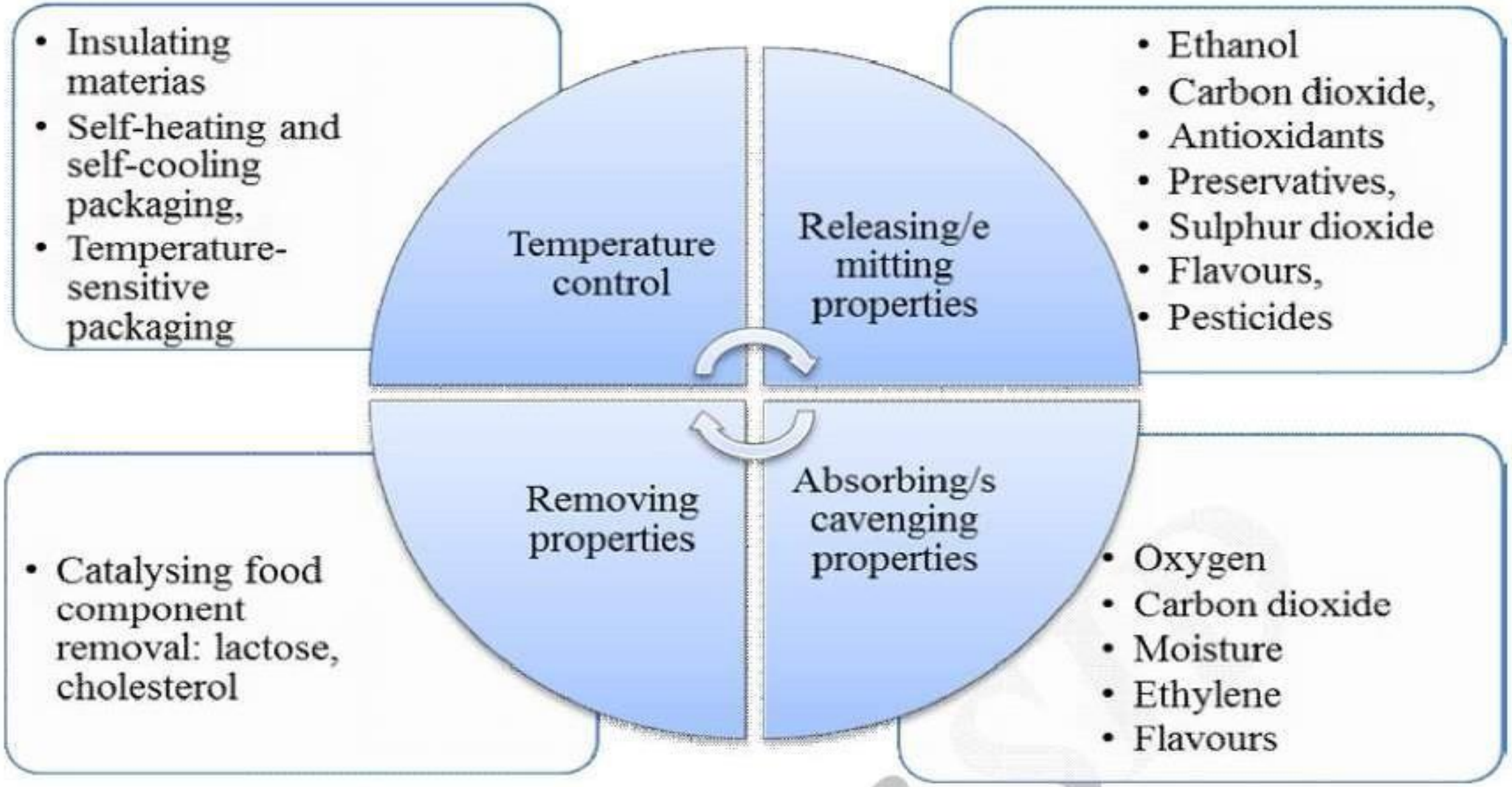
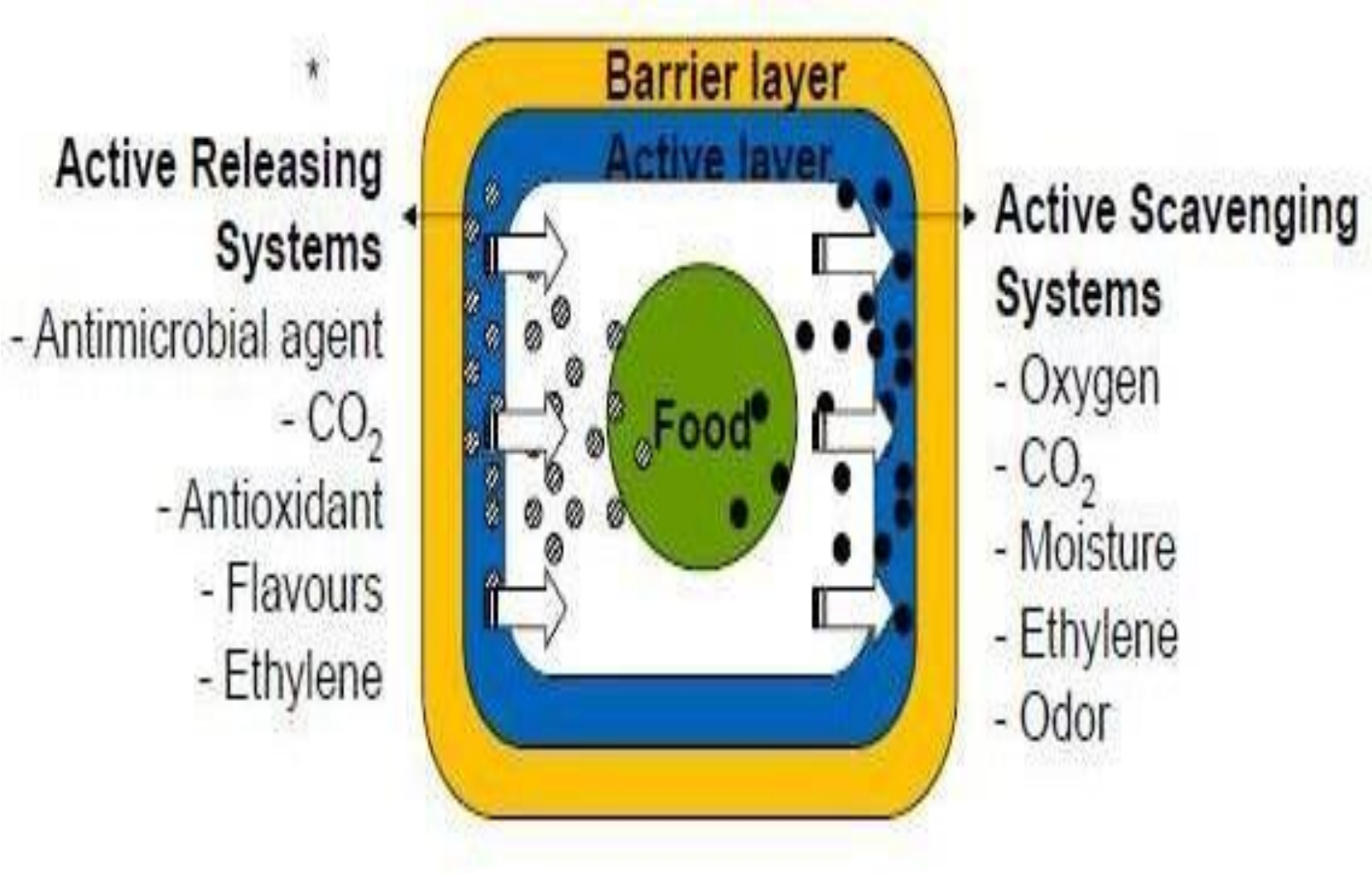
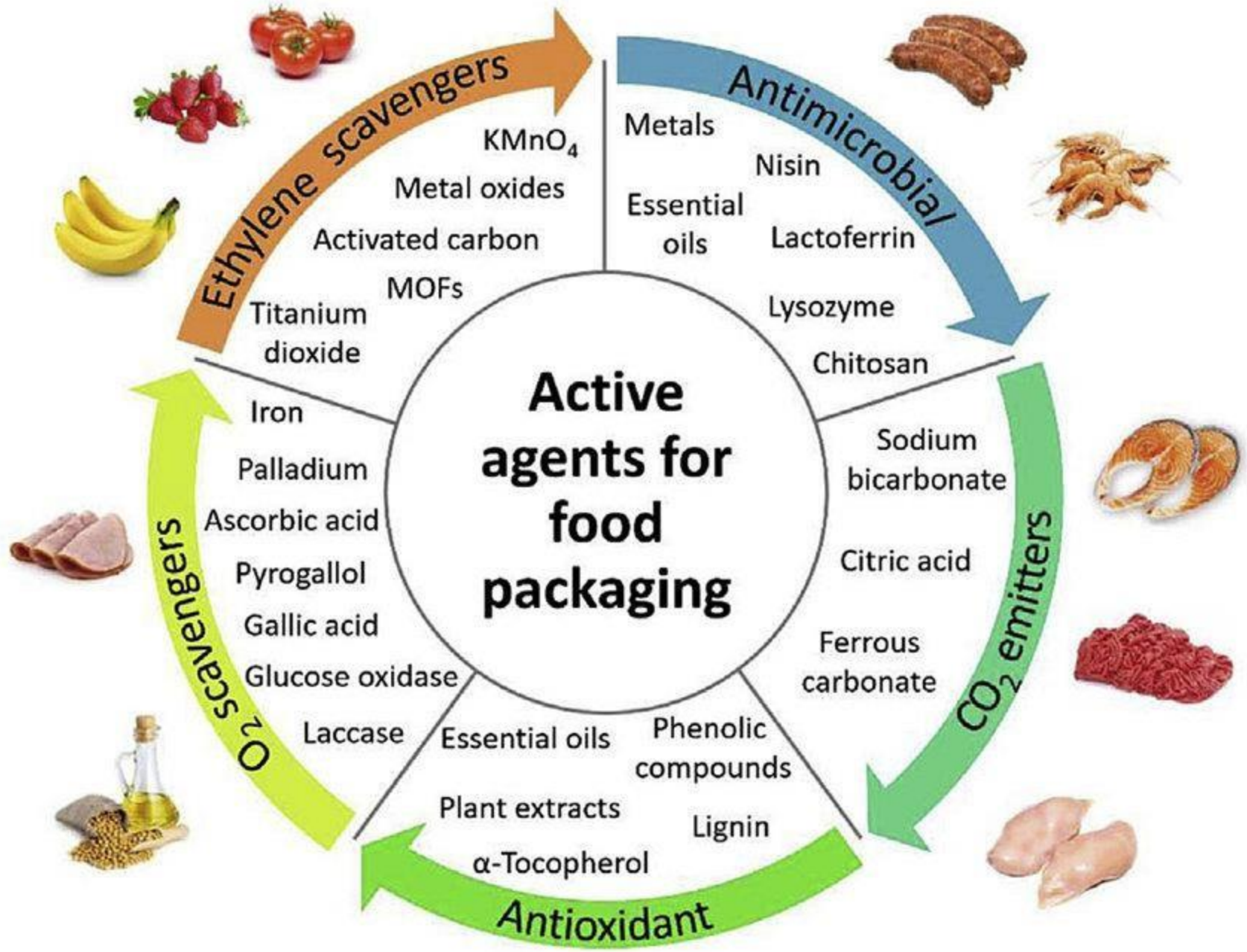


Fig.1. Examples of active packaging applications for use within the food industry.


Active Releasing Systems
- Antimicrobial agent
- CO_2
- Antioxidant
- Flavours
- Ethylene
Barrier layer
Active layer
Food
Active Scavenging Systems
- Oxygen
- CO_2
- Moisture
- Ethylene
- Odor


Active agents for food packaging
Ethylene scavengers
KMnO4
Metal oxides
Activated carbon
MOFs
Titanium dioxide
Antimicrobial
Metals
Nisin
Essential oils
Lactoferrin
Lysozyme
Chitosan
CO2 emitters
Sodium bicarbonate
Citric acid
Ferrous carbonate
Antioxidant
Essential oils
Phenolic compounds
Plant extracts
Lignin
α-Tocopherol
O2 scavengers
Iron
Palladium
Ascorbic acid
Pyrogallol
Gallic acid
Glucose oxidase
Laccase

OXYGEN SCAVENGERS

❖ presence of oxygen in food packages

-accelerates the spoilage of many foods.

-cause off-flavour development

-colour change

-nutrient loss

-microbial attack

MECHANISMS OF ACTION OF OXYGEN SCAVENGERS

- a.) Oxidation of iron and iron salts

  - oxidation of iron and ferrous salts (provided in the packet) that react with water provided by food to produce a reaction that moisturizes the iron metal in the product packaging and irreversibly converts it to a stable oxide.

  - The iron powder is contained within small oxygen permeable bags that prevent contact with food.

$$4Fe(OH)_2 + O_2 + 2H_2O \rightarrow 4Fe(OH)_3$$

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TYPES

❖ OXYGEN SCAVENGERS

- materials incorporated into package structures that chemically combine with, and thus effectively remove, oxygen from the inner package environment
    - eg:- ferrous compounds, catechol, ascorbic acid and its analogues, ligands, oxidative enzymes such as glucose oxidase, unsaturated hydrocarbons and polyamides

❖ OXYGEN INTERCEPTORS

- blocks the adverse effect of oxygen in the air on the food, before the oxygen can enter the food.

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❖ OXYGEN ABSORBERS

- absorbers remove oxygen by physically trapping the oxygen and not through chemical reaction

❖ ANTIOXIDANTS

- compounds that react with lipid or peroxide radicals or, in light, with singlet oxygen, and that are themselves oxidized to generate what are generally innocuous nontoxic compounds
    - BHA—butylated hydroxyanisole
    - BHT—butylated hydroxytoluene
    - PG—propyl gallate

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ADVANTAGES

- prevent oxidation phenomena:

Rancidity of fats and oils and consequent emergence of off-odours and off-flavours, loss or change of colours characteristic of food, loss of oxygen-sensitive nutrients

- prevent the growth of aerobic microorganisms.
- reduce or eliminate the need for preservatives and antioxidants
- slow down metabolism of food.

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CARBON DIOXIDE GENERATING SYSTEM

- High level of CO_2 (10-80%) inhibits surface microbial growth and extends shelf life

- EXAMPLES

1. ferrous carbonate
2. mixture of ascorbic acid and sodium bicarbonate

- Application: Fresh meat, poultry, fish, cheeses and strawberries

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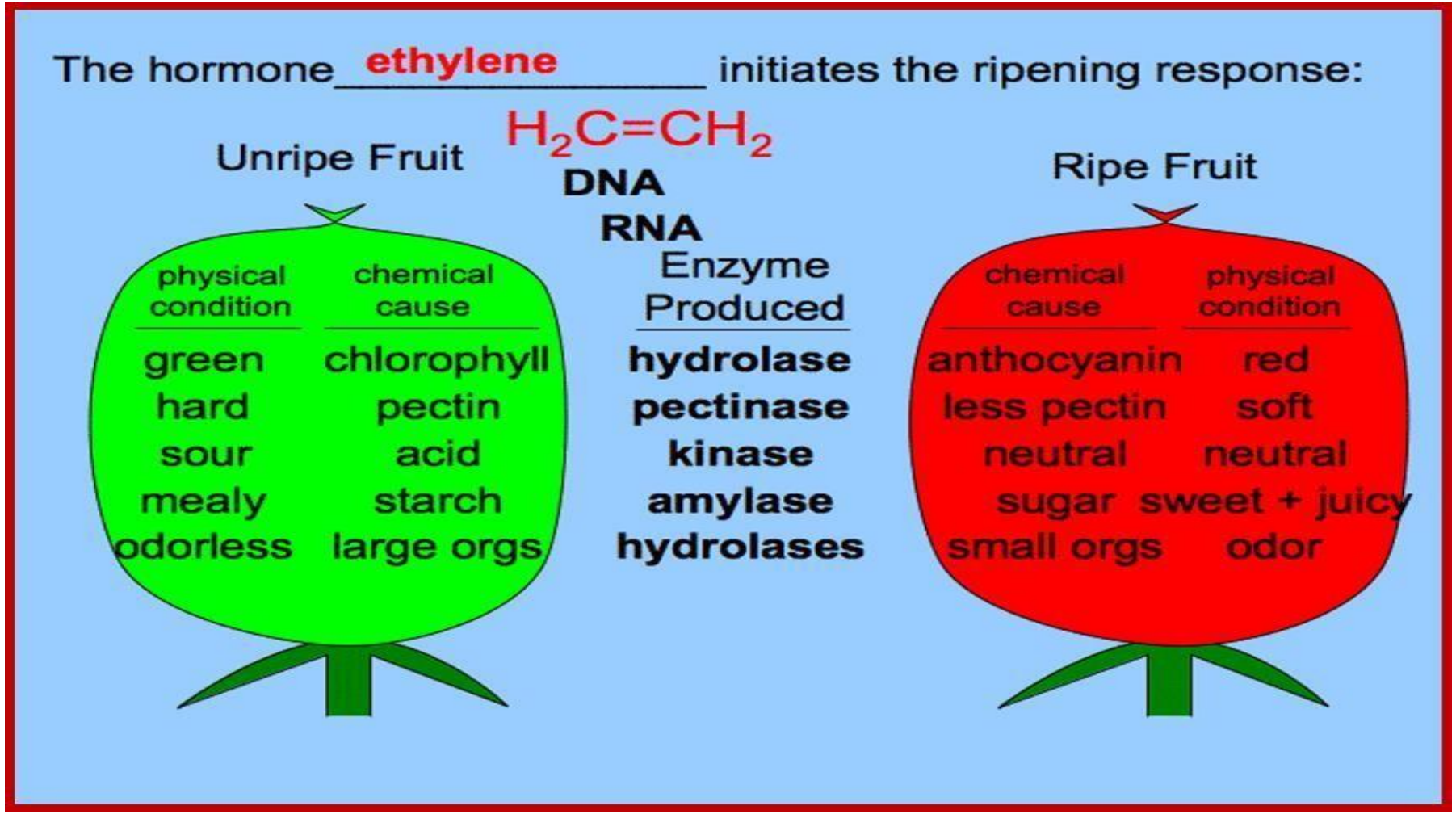
ETHYLENE


The hormone ethylene initiates the ripening response:
$H_2C=CH_2$
DNA
RNA
Enzyme Produced
Unripe Fruit
physical condition
chemical cause
green
hard
sour
mealy
odorless
chlorophyll
pectin
acid
starch
large orgs
hydrolase
pectinase
kinase
amylase
hydrolases
Ripe Fruit
chemical cause
physical condition
anthocyanin
less pectin
neutral
sugar
small orgs
red
soft
neutral
sweet + juicy
odor

Ethylene Production

Table I

Ethylene Production from Different Fresh Produce Types

Low (< 1.0 ml kg^{-1} h^{-1})	Moderate ($1–10$ ml kg^{-1} h^{-1})	High ($10–100$ ml kg^{-1} h^{-1})	Very high (> 100 ml kg^{-1} h^{-1})
Pineapple, artichoke, cauliflower, broccoli, date, orange, rhubarb, spinach, beetroot, green asparagus, celery, lemon, onion	Banana, mango, plum, tomato	Apricot, nectarine, pear, peach	Apple, avocado, cherimoya, passion fruit

ETHYLENE SCAVENGERS

- A chemical reagent, incorporated into the packaging film that traps the ethylene produced by ripening fruit or vegetables.

- pink colour-indicator of the extent of reaction and shows when the scavenger is used up.
- Examples: activated alumina, vermiculite, and silica gel that have been impregnated with potassium permanganate ($KMnO_4$).
- Activated charcoal alone or after impregnation with bromine.
- bentonite, Kieselguhr, and crystalline aluminosilicates, e.g., zeolites, have been reported capable of adsorbing ethylene

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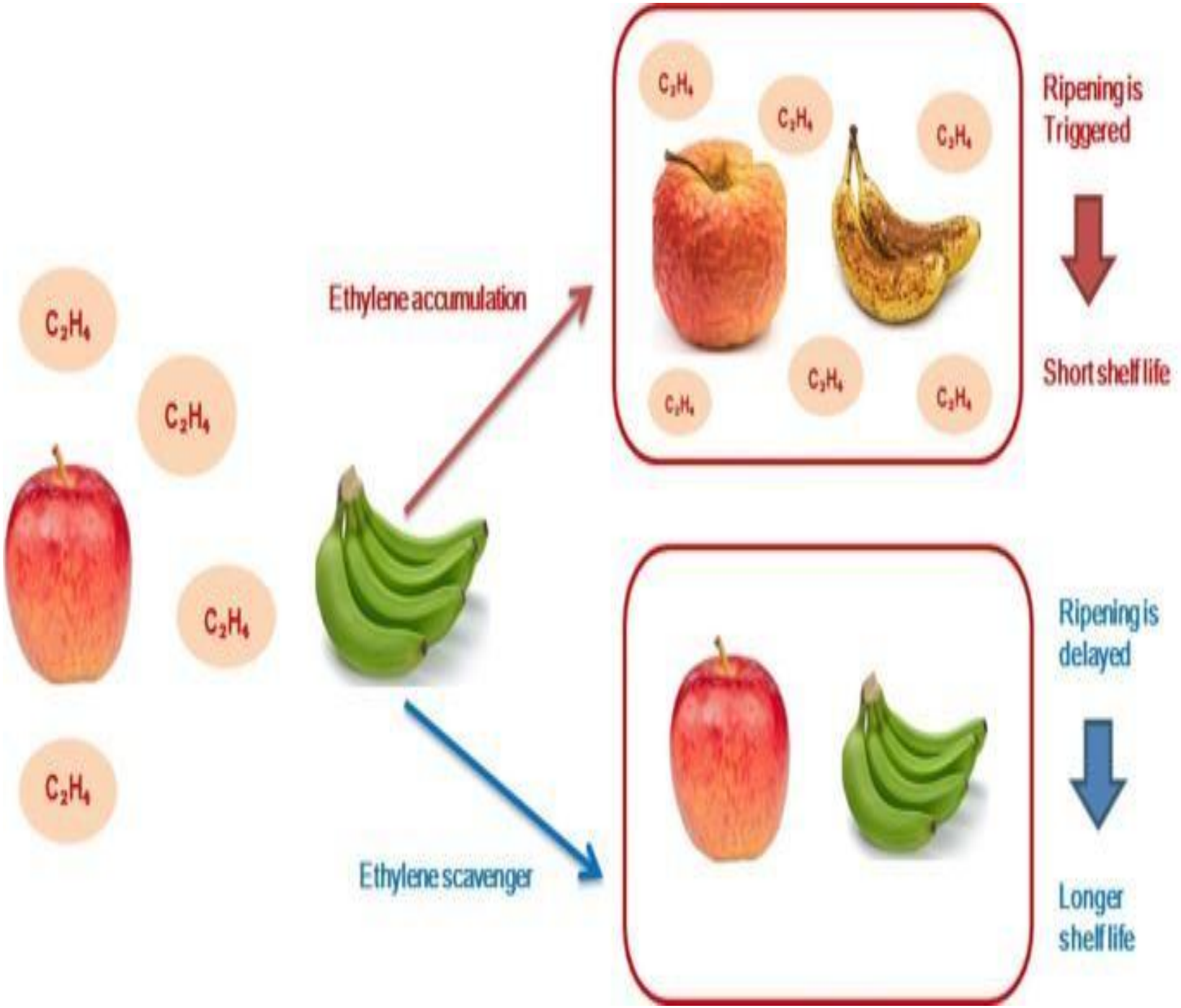
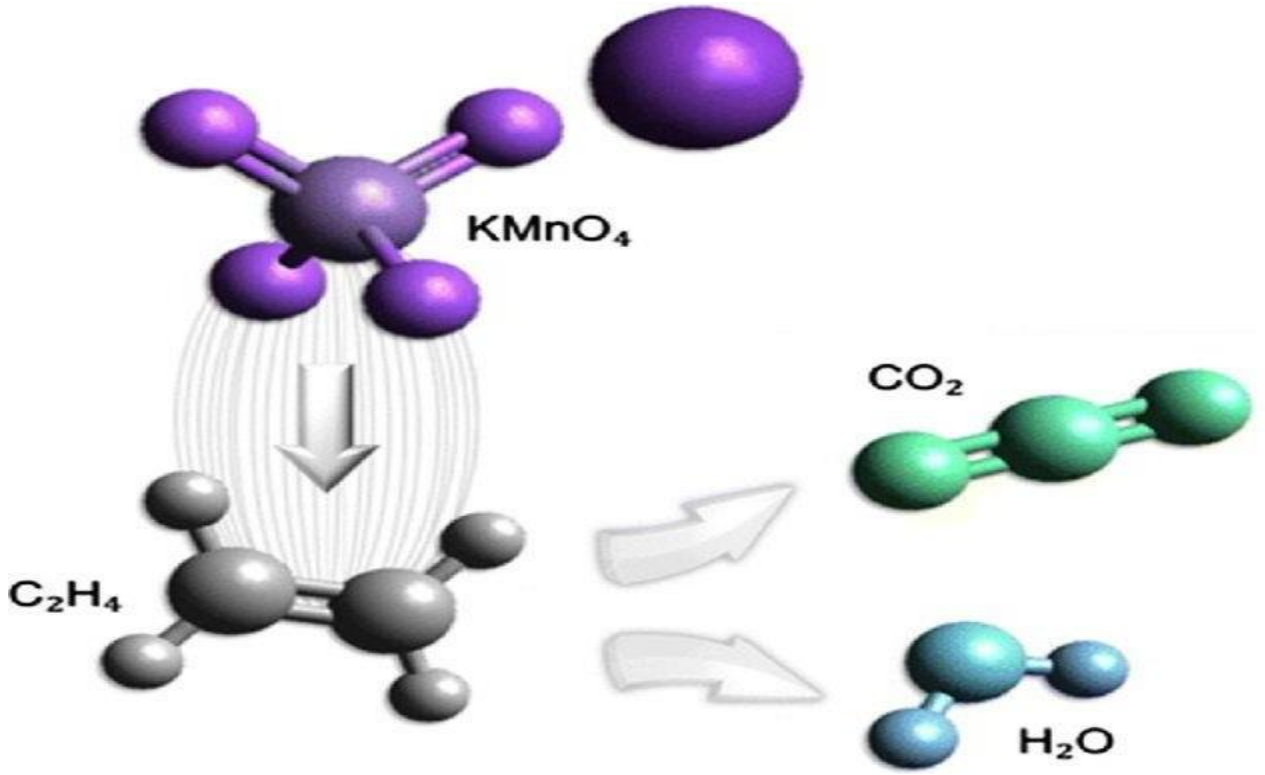
ETHYLENE!!!!!!!!


C_2H_4
C_2H_4
C_2H_4
C_2H_4
C_2H_4
Ethylene accumulation
Ethylene scavenger
C_2H_4
C_2H_4
C_2H_4
C_2H_4
C_2H_4
C_2H_4
Ripening is Triggered
Short shelf life
Ripening is delayed
Longer shelf life



•apples, bananas, mangos, tomatoes, onions, carrots.

FLAVOUR & ODOUR ABSORBER/RELEASER

- Addition of essences and odours
  - increase the desirability of the food to the consumer
  - improve the aroma of fresh product itself
  - enhance flavour of food when the package is opened.

- flavours and aromas are released slowly and evenly in the packaged product during its shelf life or release can be controlled to occur during opening the package or food preparation.
- Gradual release of odours can offset the natural loss of taste or smell of products with long shelf lives

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EXAMPLES

- Limonene.??????????????
- unpleasant smelling volatile amines, such as trimethylamine, associated with fish protein breakdown are alkaline and can be neutralised by various acidic compounds

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ANTIOXIDANTS

- The oxidation of lipids in food leads to
  - reduction in shelf-life due to changes in taste and odour
  - deterioration of texture & functionality of muscle foods
  - reduction in nutritional quality
- avoided by use of oxygen scavengers and antioxidant agents in the packaging.
- oxidation can be avoided by eliminating radicals(oxo, hydroxyl, and superoxide) as soon as they are formed.

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EXAMPLES

- Avarnish with natural antioxidant of rosemary
- Antioxidant active film- conservation of fresh meat
  - enhance the stability of myoglobin and fresh meat against oxidation processes.
- Migration of α-tocopherol
  - delay in lipid oxidation in whole milkpowder
- . Antioxidants can be used for oil, nuts, butter, fresh meat, meat derivatives, bakery products, fruits and vegetables.

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HUMIDITY CONTROL

- Condensation or 'sweating' is a problem in many kinds of packaged fruit and vegetables.
- When the condensation inside packages is controlled, the food remains dry without drying out the product itself.
- sensitive products such as flowers and table grapes
  - reduce the growth of mold.

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EXAMPLES

- Silica gels
- Molecular sieves (Zeolites)
- Cellulose fibre pads (Soaker pads) in the bottom of meat, poultry, and fresh produce trays.

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ANTIMICROBIAL PACKAGING

- prevents growth of micro-organisms

❖ EXAMPLES

- ethanol, carbon dioxide, silver ions, chlorine dioxide, antibiotics, organic acids, essential oils and spices, etc

- Packaging systems that release volatile antimicrobials also include chlorine dioxide, plant extracts, sulphur dioxide, essential oils, carbon dioxide release systems

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- classified into two types:
- those containing antimicrobial agents that migrate to the surface of the package material and thus can contact the food,
- those that are effective against food surface microbiological growth without migration of the active agent(s) to the food.

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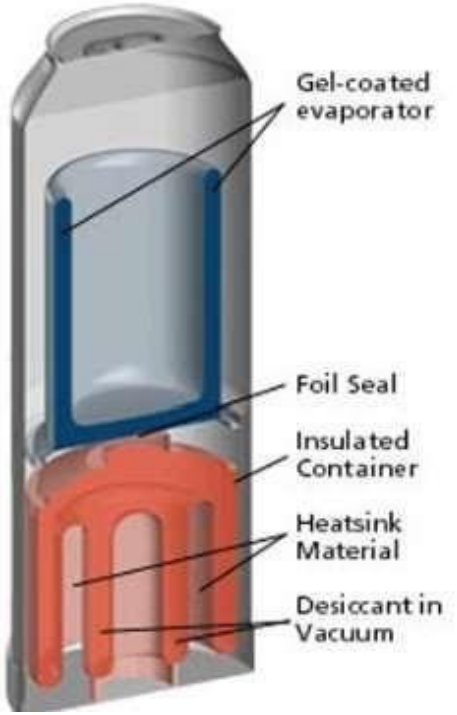
Self Heating Packaging

Self Cooling Packaging



ACTIVE PACKAGING –THE FUTURE

These packaging technologies anticipated to grow significantly over the next 10 years, due principally to:

- Consumer demands for meat and other food products which are premium qualities and which provide adequate shelf-life, safety, convenience and information

- Reduction in packaging material costs as formats grow in popularity/sales volume, and as newer and cheaper formats emerge through research and development

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•Greater demands by retailing outlets for extended product shelf-life

•Concerns regarding product authenticity and bio-terrorism

•Growing efforts to reduce unnecessary product/package wastes

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Any Question


Thank
You!