Storage

Fumigation, Packaging, Controlled and modified atmosphere storage, Perishables

Fumigation

- **Fumigation** is a method of pest control that completely fills an area with gaseous pesticides—or **fumigants**—to suffocate or poison the pests within.
- **Fumigants**
  - Methyl bromide (use of fan and ducting to recirculation of gas) – 0.06m^2/min/t
  - Phosphine (Placements of pallets/ Placed in blanket form) – 0.5 to 1.0g phosphine per cubic metre

Packaging

For safeguarding the food material from mechanical, physical, chemical and biological activities.

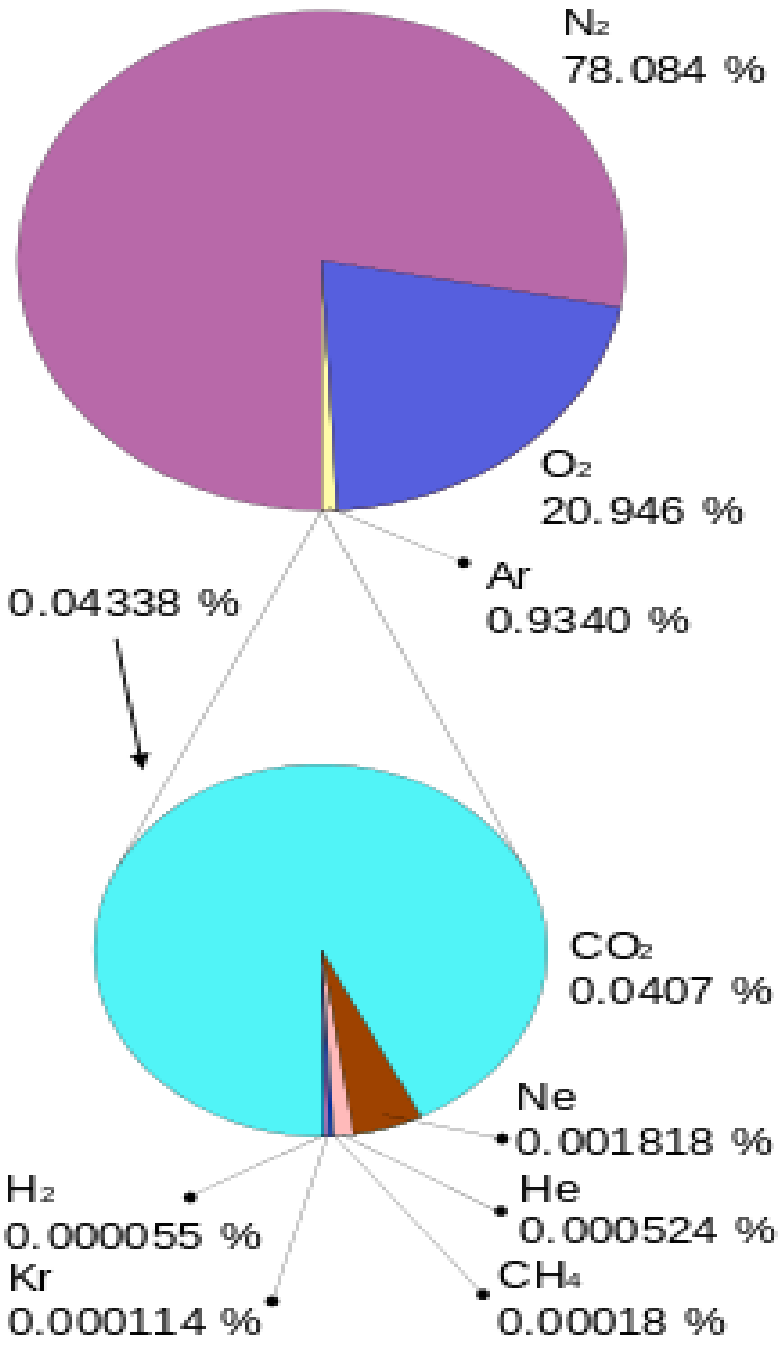
- Easy handling of products
- Protection to the products
- Maintain the original quality during transport and storage
- Storage at retailing and consumer level

Types of packages

- **Flexible materials –** Plastic films, laminations, Polythene, polypropylene, special coating and waxes
- **Rigid plastic containers –** Plastic creates, plastic bottles, cans
- **Rigid packages –** Glass bottles, metal cans, cartons, corrugated cases and wooden cases
- **Composite cans –** Recycles waste papers, aluminum foil or plastic

Controlled and modified atmosphere storage (Composition of Gases)

- dry air contains
- **78.09%** nitrogen,
- **20.95%** oxygen,
- 0.93% argon,
- 0.04% carbon dioxide, and small amounts of other gases.
- Air also contains a variable amount of water vapor, on average around 1% at sea level, and 0.4% over the entire atmosphere.



Controlled and modified atmosphere storage

- For increasing the shelf life of fruits and vegetables, reducing oxygen level in the storage by increasing carbon dioxide or other gases.
- Green tomatoes – 5-6 weeks at 13°C at 3% oxygen and 97% nitrogen - remained green.
- Mushroom kept fresh longer at increase of 5 – 10% carbon dioxide

Modified atmosphere storage conditions

Commodity	Temperature range (°C)	Modified Atmosphere	
		% O_2	% CO_2
Broccoli	0-5	1-2	5-10
Cabbage	0-5	3-5	5-7
Cauliflower	0-5	2-5	2-5
Sweet corn	0-5	2-4	10-20
Cucumber	8-12	3-5	0
Okra	8-12	3-5	0
Onion (green)	0-5	1-2	10-20
Potato	4-12	None	None
Spinach	0-5	Air	10-20
Tomato(partially ripe)	8-12	3-5	0

CA Storage	MA Storage
High degree of control over gas conc.	Low degree
Longer storage life	Less
More expensive technology	Less
Atmosphere is modified by adding gas	It is created by either actively(addition or removal of gas) or passively (produce generated)
Specific temperature should maintained	May or may not be maintained

Airtight storage

- These are used to arrest the insect infestation in dry grains and to protect comparatively wet grains from the mould attack.
- Insects are killed if oxygen level falls below – 2% level
- Most of the fungi on damp grain can grow up to 0.2% oxygen level.

Storage of perishables

- **Decrease the temperature**

  Lowering the temperature decrease the respiration rate of vegetable and thus slows down the degradation of sugar and other carbohydrate materials of the cells
- **Types of storage facilities**
  - Cold storage (-1 to 10°C)
  - Freezer/ Frozen storage (below -1°C)

Cooling of fruits and vegetables

- Type of heat to be removed -
  - Sensible heat of the product
  - Heat of respiration
- Common methods of cooling –
  - Contact icing
  - Hydro cooling

Low Pressure Storage/ Hypobaric Storage

- Fruits can be stored under low pressure of 0.2 – 0.5 atmospheric pressure and temperature of 15 – 24°C under airtight chamber. Pressure is reduced by sucking air and creating vacuum.

- Reduced O_2 supply slows down the respiration. When presser reduced from the 1 atm to 0.1atm the effective O_2 concentration reduced from 21 to 2.1%.

Comparative storage life (in days) of produce stored in refrigeration and under hypobaric conditions

Commodity	Cold storage	Hypobaric storage
Fruits (fully ripe)		
Pine apple (ripe)	9-12	40
Strawberry	5-7	21-28
Sweet cherry	14	60-90
Fruits (unripe)		
Banana	10-14	90-150
Apple	60-90	300
Pear	45-60	300
Vegetables		
Green pepper	16-18	50
Cucumber	10-14	41
Beans	10-13	30
Onion (green)	2-3	15
Tomato(mature green)	14-21	60-100
Tomato(breaker stage)	10-12	28-42

General recommendations for perishables

Temperature °C	RH %	Crops
0 – 2	90 – 98	leafy vegetables, crucifers (cauliflowers etc.), temperate fruits and berries
7 – 10	85 - 95	citrus, subtropical fruits and fruit vegetables
13 - 18	85 – 95	tropical fruits, melons, pumpkins and root vegetables