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Controlled Atmospheres & Fumigation for Stored Product Protection

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# Stored Products

<table>
<thead>
<tr>
<th>AGRICULTURAL</th>
<th>ANIMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Durables</strong> <em>(Dry)</em></td>
<td><strong>Perishables</strong> <em>(Fresh)</em></td>
</tr>
<tr>
<td>Food- raw</td>
<td>Cut flowers, fruits, tubers &amp; vegetables</td>
</tr>
<tr>
<td>(Cereals, pulses, oilseeds, dry fruits, tree nuts, spices, beverage crops, cassava)</td>
<td></td>
</tr>
<tr>
<td>- processed</td>
<td></td>
</tr>
<tr>
<td>(Flour, semolina, pasta, powdered spices, cocoa powder, coffee seeds)</td>
<td></td>
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<tr>
<td><strong>Non-food</strong></td>
<td></td>
</tr>
<tr>
<td>(Tobacco, cotton, dried flowers, seed materials, oilcakes/meals, whole logs, timber, cultural artefacts)</td>
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</tbody>
</table>
Pest attack starts from production till end use

- Intact raw food commodities
- Processed/milled products
- Packaged products
- Processing facilities
- Transport facilities
- Storage facilities
Pest management is essential as infestation leads to:

1. Quantitative loss
2. Product contamination
3. Moisture increase, moulds, mycotoxin issues

Marketability of the commodity is affected
Pest control options

**Chemical Fumigants**
- Fast action
- Major role in QPS
- Versatile applicability

**Controlled Atmosphere**
- Residue-free
- Preferred for organic market
- Long term storage suitable
<table>
<thead>
<tr>
<th></th>
<th><strong>Fumigants</strong></th>
<th><strong>Global status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phosphine (AlP, MgP)</td>
<td>Worldwide use</td>
</tr>
<tr>
<td>2</td>
<td>Methyl bromide</td>
<td>QPS &amp; CUE</td>
</tr>
<tr>
<td>3</td>
<td>Sulfuryl fluoride</td>
<td>Some countries</td>
</tr>
<tr>
<td>4</td>
<td>Ethyl formate</td>
<td>Some countries</td>
</tr>
<tr>
<td>5</td>
<td>HCN</td>
<td>Europe</td>
</tr>
<tr>
<td>6</td>
<td>Ethane dinitrile</td>
<td>Australia, New Zealand</td>
</tr>
<tr>
<td>7</td>
<td>Propylene oxide</td>
<td>USA, Japan</td>
</tr>
</tbody>
</table>
## Registered Fumigants, India

<table>
<thead>
<tr>
<th>FUMIGANT</th>
<th>FORMULATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Aluminium phosphide</strong> (Phosphine)</td>
<td>Tablets: 56%, 6%, 15% (12g), Powder: 56%, Granules: 77.5% (Total 5 formulations)</td>
</tr>
<tr>
<td>Magnesium phosphide (Phosphine)</td>
<td>56% FI &amp; FIM (2 formulations)</td>
</tr>
<tr>
<td><strong>2. Methyl bromide</strong></td>
<td>99% L, 98% L (+2% CPN) (2 formulations)</td>
</tr>
<tr>
<td><strong>3. EDCT</strong></td>
<td>3:1 mixture (1 formulation)</td>
</tr>
</tbody>
</table>
Loss prevention at Farmer level

Rigid container, 15% AlP
12 g tablets x 4 or 5 nos

Pouch contains 56% AlP
10 g powder per pack
Loss prevention at state/central storage level
Sheeted fumigation of bag-stacks with AlP (phosphine) tablets/sachet
Loss prevention at bulk storage level
Phosphine fumigation using on-site generator
PH$_3$ Monitoring Equipment

- Uniphos 350M PH$_3$ Leak Detector
- Uniphos Fumisense Pro-Hi-Gas Monitor
- Phosphine Strips
- Gas Detection Tubes
- 4-Zone Automatic PH$_3$ gas monitor
Silo fumigation: Fumitrack automated monitoring
FROM FUMIGATION CHAMBER / SILO

P1

P2

P3

P4

Purgin

Sampling from Port1
Sampling from Port2
Sampling from Port3
Sampling from Port4

Purge back to silo
Purge back to air

PUMP

SENSOR
Controlled atmosphere (CA) for food commodity storage

<table>
<thead>
<tr>
<th>Atmos. Gas</th>
<th>Concentration</th>
<th>Exposure time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low O$_2$</td>
<td>$\leq 1%$ (99% N$_2$)</td>
<td>21 days</td>
</tr>
<tr>
<td>CO$_2$ rich</td>
<td>$&gt;35%$</td>
<td>15 days</td>
</tr>
</tbody>
</table>
Preparation for CO$_2$ treatment of *Basmati* rice (2001)
Now, ready-to-use gastight enclosures, ‘cocoons’, 1 to 1000 ton storage capacity, are available

Food & non-food industries in India (besides EcO$_2$/ZerOx/ B-Cat System) use ‘cocoons’ for hermetic storage & CA treatment
High pressure CO$_2$ treatment (very short exposure period) is yet to be practiced in India.
To sum up

The predominant role of chemical fumigants in stored product protection will continue due to rapid action & versatility.

CA treatment will have its role in niche areas such as organic market, high-value products & long term storage.

Accordingly, fumigants & CA are exploited for loss reduction in stored products & to meet the market demands.
Thank you