# Postharvest Management of Lemon

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Citrus fruits being non-climacteric have a relatively short post-harvest life in stark contrast to the climacteric fruits like mango, banana and sapota. In a developing country like India, post-harvest losses of citrus fruits are in the range of 25-30%. This is mainly due to the unscientific practices of picking, handling, packaging, transport and storage. However, with the thrust given to agriculture modernization from 11th five-year plan, several post-harvest technologies have been developed to minimize the post-harvest losses. Post-harvest treatments such as curing, washing, wax coating with fungicide have contributed to minimize post-harvest losses in the last decade.

## **Maturity Indices**

Minimum juice content by volume of 28 or 30% depending on grade; color lemons picked at the darkgreen stage have the longest postharvest life while those picked fully-yellow must be marketed more rapidly.

## **Quality Indices**

- Yellow color intensity and uniformity
- Size
- Shape
- Smoothness
- Firmness
- Freedom from decay
- Freedom from defects including freezing damage, drying, mechanical damage, rind stains, red blotch, shriveling, and discoloration.

## **Optimum** Temperature

12-14°C (54-57°F) depending on cultivar, maturity-ripeness stage at harvest, production area, and duration of storage and transport (can be up to 6months).

# **Optimum relative humidity -** 90-95% **Rates of respiration**

Temperature	10°C	15°C	20°C
	(50°F)	(59°F)	(68°F)
ml CO <sub>2</sub> /kg hr	5-6	7-12	10-14

To calculate heat production multiply ml  $CO_2$  /kg hr by 440 to get BTU/ton/day or by 122 to get kcal/metric ton/day.

# **Rates Of Ethylene Production**

<0.1 µl/kg hr at 20°C (68°F)

# **Responses To Ethylene**

If degreening is desired, lemons can be treated with 1-10 ppm ethylene for 1-3 days at 20 to 25°C (68-77°F), but this exposure may accelerate deterioration rate and decay incidence.

# **Responses To Controlled Atmospheres (Ca)**

CA of 5-10%  $O_2$  and 0-10%  $CO_2$  can delay senescence including loss of green color of lemons. Fungistatic  $CO_2$  levels (10-15%) are not used because they may induce off-flavors due to accumulation of fermentative volatiles, especially if  $O_2$  levels are below 5%. Removal of ethylene from lemon storage facilities can reduce rate of senescence and decay incidence.

## **Physical Disorders**

## Oil spotting (Oleocellosis)

Breaking of oil cells due to physical stress on turgid fruits causes release of the oil that damages



surrounding tissues. Avoiding harvesting lemons when they are very turgid and careful handling reduces severity of this disorder.

# Physiological Disorders Chilling injury





Symptoms include pitting, membranous staining, and red blotch. Severity depends upon cultivar, production area, harvest time, maturity-



ripeness stage at harvest, and time-temperature of postharvest handling operations. Moderate to severe chilling injury is usually followed by decay.

#### **Pathological Disorders**

Green mold: Caused by *Penicillium digitatum* which penetrates the fruit rind through wounds. Symptoms begin as water-soaked area at the fruit

surface followed by growth of colorless mycelium, then sporulation (green color).



 Blue Mold: Caused by *Penicillium italicum* which can penetrate the

uninjured peel and can spread from one lemon to

adjacent lemons. Symptoms are similar to green mold except that the spores are blue.



 Altenaria rot: Caused by *Alternaria citri* which enters the lemons

through their buttons. Preharvest treatment with

gibberellic acid or postharvest treatment with 2, 4-D delay senescence of the buttons and subsequent decay by Alternaria.



## Fruit Handling to Avoid Postharvest Losses

Green and blue molds and sour rot usually develop on fruit where the rind has been physically damaged. Without this injury site the fungal spores do not grow and cannot penetrate the fruit surface.

By following these few tips, you will reduce postharvest losses:

- > Do not leave harvested fruit out in the hot sun;
- Do not pick cold, wet fruit. When wet turgid fruit is handled the oil glands can be ruptured. The released oil burns the fruit surface (oleocellosis) and also stimulates fungal spores to germinate. The burn marks can take 2-3 days to develop.

- Wear cotton gloves when harvesting. This reduces puncture marks from fingernails and jewelry
- Use picking bags. This reduces damage as a result of abrasion on wooden or metal picking bins and allows fruit to be gently lowered into bulk harvesting bins.
- Do not leave stems on fruit or damage buttons by "plugging".
- > Use clean, smooth harvesting bins.
- Make sure packing line equipment is cleaned regularly. This reduces dirt and wax buildup which can cause fruit abrasion.
- Reduce packing line abrasion by using foam, rubber and smooth belts to cushion fruit.
- Remove all old fruit regularly from the packing shed and surrounds.
- Treat harvested fruit with a registered fungicide within 24hrs of harvest.
- Don't leave rejected/rotten fruit in or around the packing shed or orchard.

## **Storing Lemons**

Lemons are non-climacteric fruit and have low respiration rates. They are therefore able to be stored for long periods of time. In contrast to other citrus varieties there are significant changes in the internal quality of lemon fruit during storage. During storage the percentage of juice increases (by up to16%) primarily due to the water stored in the peel. The acid content of fruit also increases (by up to 24%) during storage and the peel color changes from green to yellow.

Lemons are sensitive to cold temperatures and should not be stored at temperatures below 10oC as they develop chilling injury. The length of time lemons can be stored depends on the stage that they are picked. Fruit harvested with a yellow tinge can be stored for a few weeks, silver-green fruit 6 weeks, light green fruit 2 months and dark green fruit 5-6 months.

## Advantages

- Possibility of achieving higher market prices when local fruit is in short supply.
- Better quality main crop lemons. The main winter crop if stored is usually smaller with thinner skins



Stored fruit have been shown to have higher juice content

# Disadvantages

- Moisture loss from stored fruit. Unwaxed fruit can lose about 5% of their weight/month. Applying wax should reduce this by 30-40%.
- > Additional costs of running the cool room.
- Overstored fruit can develop a deep yellow colour that makes them appear old.
- High capital costs if a storage facility has to be specially built.
- Competition on the market from other stored fruit and from imported fruit.

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