On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
the Federal Republic of Germany
Cold Chain Logistics Resource Centre
Confederation of Indian Industry

Post-Harvest Management Protocols

ORANGE

Orange belongs to the citrus fruit category and is also addressed as sweet orange. India is the third largest producer of oranges in the world after US, Indonesia and Turkey. India exports more than 25 thousand tonnes to countries like Bangladesh, Kuwait and Oman etc. **Total orange production for the year 2017-18 was 3265.83('000 MT)** and major Orange producing state are Andhra Pradesh, Maharashtra, Telangana, Madhya Pradesh and Punjab.

Important mandarin orange varieties cultivated in India

- Nagpur Santra
- Coorg Santra
- Khasi Santra
- Mudkhed
- Shringar
- Butwal
- Dancy
- Kara (Abohar)
- SZ-IN-COM
- Darjeeling Mandarin
- Sumithra mandarin
- Seedless-182
- Kinnow mandarin

MATURITY INDICES

The maturity of harvested fruits has an important role on shelf life, quality, and market price. Generally, the Mandarins are harvested in 32-36 weeks after the fruit is set. The most commonly used measures to access maturity for harvesting the Mandarin is peel colour. Fruits are considered mature, if they have a yellow orange colour on 25% or more of the fruit surface. Fruit quality for harvesting depends upon SS (soluble solids contents, sugar) and acidity of the juice. The juice should have a SS of 8.5% or higher. SS content is determined by squeezing a few drops of juice on a hand-held refractometer.

Wax development on surface and juice content of minimum 40% are also important indicators. Orange is harvested Pre – Harvest in green colour stage as it acquires colour from heat and moisture. The harvesting is done using a pair of clippers or by carefully twisting and pulling the fruit from tree so that button remains attached to the fruits.

POST-HARVEST HANDLING

PRECOOLING

Pre-cooling is done in Orange as the removal of field heat is required from freshly harvested produce to slow down metabolism and reduce deterioration prior to transport or storage.

Degreening constitutes conversion of chlorophyll of the peel without influencing the internal quality of the fruit. In de-greening, the yellow-orange fruits with green spots could be de-greened in 48 hours at 26-28°C and 90-95 RH at nearly 5 ppm ethylene concentration. The signs of maturity include orange to yellow fruit colour, firmness, proper formation with 50mm to 60mm in diameter.

GRADING

The fruits are sorted out, based on physical characteristics like weight, size, color, shape and degree of damage on fruits. This type of grading is done by hand in small operations. 19 In pack houses handling large volume of the produce, semi- automatic grading machines are also used, wherein the fruits are passed down on a slow-moving conveyor.

WAXING

Waxing can be done to reduce water loss & shrinkage and extend storage life. The storage life can be extended to 2-3 weeks at RT and 4-6 weeks at 6-8°C.

- Waxes commonly used: Semperfresh, waxol, Stayfresh etc
- Conc. of Wax emulsion: 3-6 %
- Waxing can be coupled with fungicide (0.1%)

Precautions

Produce should be clean & dry before waxing Optimum thickness Too thick: off flavour Too thin : little effect Dry properly before packing

PACKAGING

For Local transport, Nylon bags, wooden boxes or CFB boxes with layers of grass, leaves and paper shreds as a cushioning material.

For Export market. Box Type: CFB (5-7 ply) : Two piece full or half telescopic Size : 50x 30 X 30 cm Eight boxes per layer on 1 x 1.2 m pallet

STORAGE

In some states fruits mandarins are kept in cold storages for a period of 30-40 days at a temperature of 4.5°C at 90-95% RH. In some states fruits are stored at ambient temperature.

Storage Parameters

Recommended Temperature (in degree Celcius)

5-7

Recommended Relative Humidity (in %)

85-90

Shelf Life

2 to 2 Weeks

Product Loading Density (in Pound/cu.ft)	-
Initial Freezing Point (in degree Celsius)	-0.8
Specific Heat Above Freezing Point in (kJ/Kg.K)	3.81
Specific Heat Below Freezing Point (in kJ/Kg.K)	1.98
Latent Heat of Fusion (in kJ/Kg)	304

Thermal properties of Orange

Initial Freezing Point (in degree celcius)	-1.1
Specific Heat Above Freezing Point in (kJ/Kg.K)	3.65
Specific Heat Below Freezing Point (in kJ/Kg.K)	1.89
Latent Heat of Fusion (in kJ/Kg)	278