

Post-Harvest Management Protocols

APPLE

Apple is commercially the most important temperate fruit and is fourth among the most widely produced fruits in the world after banana, orange, and grape. China is the largest apple producing country in the world followed by India. Total production of apple in India for the year 2017-18 was 2326.90 ('000Tonnes) out of 77.7% production share hold by Jammu & Kashmir.



Varieties of apple available in India

- Ambri Apple
- McIntosh Apple
- Granny Smith
- Golden Delicious
- Honeycrisp
- Sunehri
- Lal Ambri
- Chaubattai Anupam
- Red Delicious
- Tydeman's Early
- Fuji Apple
- Red Gold
- Golden Spur
- Parlin's Beauty
- Gala Apple
- Irish Peach
- Starking Delicious
- Mollies Delicious
- Benoni
- Starkrimson

Apple producing key states in India

- Jammu & Kashmir
- Himachal Pradesh
- Uttarakhand
- Arunachal Pradesh
- Kerala

MATURITY INDICES

For the production of quality apples, harvesting at the correct time is essential. **Apples should be harvested when they are fully mature but not when fully ripe or overripe.** If fruits are harvested before they have matured fully, they will be more susceptible to storage disorders and will turn bitter in taste.

Apples are very susceptible to bruising and mechanical damage, therefore should be handled carefully as this will lead to further deterioration in quality while storing and will reduce the market value of the produce.

Days From Full Bloom (DFFB) or mean days lapsed after full bloom- 110-120 (red and royal) & 135-145 days for golden, other maturity parameter are- size (55-85mm), weight and colour of the flesh-if its green its raw and maturity is defined by the % of redness (60-100% colour), Seeds turn into darker colour on full maturity, Pressure of flesh or flesh firmness comes down

with maturity advances (a young mature fruit sounds like a wood which is a criteria to judge apple quality), acidity level decreases (TSS-12 degree Brix of a mature apple), starch of fruit turns to sugar with maturity, 80-100% colour is good quality apple (50-75% colour is a harvesting stage as apple changes colour after harvest due to an ethylene releaser), ease of separation from spur and starch iodine score and aroma are also a criteria of maturity.

POST-HARVEST HANDLING

After harvesting fruits should be washed to remove any form of debris on the surface. After washing damaged or defective fruits should be sorted. Washing may not be a regular practice unless apple is to be imported and waxing must be carried out.

Once the sorting is done fruits can be graded according to size and color.

PRECOOLING

Harvesting of apples should be done should be done in cooler hours of the day, generally in apple producing states, they are left open overnight to bring down the temperature of the fruits.

Apples are to bring down the temperature of harvested fruits equivalent to ambient temperature. A delay of 1 day at 21°C after harvest takes 7 to 10 days off the potential storage life at 0°C. A delay of 3 days in the orchard or in a warm packing shed may shorten their storage life as much as 30 days, even if they are subsequently stored in CA at -1°C.

Therefore, adequate refrigeration capacity to handle the maximum heat load is essential during room cooling. If adequate refrigeration and air circulation and not provided, apples may take several weeks to cool and thereby storage life is shortened. The desirable goal is for temperature of fruit in the centre of the stacks to drop to 0°C to 0.6°C in 2 to 4 days.

However, to reduce the cooling load and make the cooling process as energy efficient as possible, apple temperatures should be as low as possible before cooling begins.

Various methods that can be adopted for cooling of apples are:

Room Cooling

This is a simple method where the apple boxes are simply stacked inside a refrigerated room, where the heat is allowed to dissipate slowly.

Forced Air Cooling

This method is accompanied by exposing the bulk boxes in a storage room to a higher air pressure on one side. In this method, it is necessary that apple containers have sufficient open space to allow for air movement.

Hydro Cooling

In this method fruits are flooded with large volumes of Chilled water.

PACKAGING OF APPLES

- Apple is packed in count of 80 (Extra-large), 100 (large), 125 (LMS), 150 (LMS), 175 (LMS), 210 (extra small), 300 (Pitthoo)
- Apple weight in boxes should be not more than 20 kg and 4 layer and 10kg and 2 layers to protect it from bruising and pressure damage.
- Apples are generally packed with in cardboard cartons with lids, use of corrugated trays is very effective for transport at it prevents the fruits from bruising. Apple is packed in 4-5 layer in LMS packing style with box weight of 25-30 Kg. Different types of packaging used for Apple is depicted in the figures below:

Types of Apple packaging



Note: Usage of Polybags/Styrofoam packaging materials are not allowed as per the latest government regulations on single use plastic

STORAGE PROTOCOLS FOR APPLE

Apples can be stored with other temperate fruits if they have the same temperature requirements. Vegetables like cabbage and onions should not be stored with apples as apples absorb their odour. Similarly, fruits and vegetables sensitive to ethylene at 0°C should not be stored with apples.

Storage Parameters

Recommended Temperature
(Long storage in degree Celsius)

0 to 3



Recommended Relative
Humidity (in %)

90-95



Shelf Life (Long store)

3-8 Months



Recommended Temperature
(Short Storage)

3 to 8



Shelf Life (Short store)

**30 days for imported variety/
10 day for local variety**



Product Loading Density (in Pound/cu.ft)	28
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

Thermal properties of Apple

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CONTROLLED ATMOSPHERE STORAGE

Recently controlled atmosphere (CA) technology has increased steadily and is contributing significantly to extend the post-harvest life quality of apples. CA storage prolongs the shelf life of apples by lowering the oxygen concentration and increasing the carbon-dioxide concentration in the storage atmosphere.

Controlled Atmosphere (CA) storage uses oxygen and carbon dioxide concentrations of about 1% to 5% for each gas in most applications.

