



## STORAGE OF FRUITS AND VEGETABLES

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#### Handling of Fruits and Vegetables

Much of the success or failure in storing fruits and vegetables depends on having sound material at the start. All cut, bruised, frosted or otherwise damaged or mis-formed specimens should be rejected or placed aside for immediate consumption. Care should also be taken to see that the fruits or vegetables are well matured and are handled with as little abuse as possible. Where curing is advocated, it has been known that the thorough curing has had more effect on the storage behaviour than the treatment in storage.

Furthermore, the stored material should be examined frequently during storage. If wilting is noted, steps should be taken to increase the humidity either by sprinkling the floor of the storage or moistening the sand in which the root crops may be buried. If rot or any form of breakdown or other disease is noted, no matter how slight, it is better that affected specimens be rejected or at least separated from the sound material. If left in contact with sound fruit, the healthy specimens are likely to become tainted or otherwise affected. What is more, rotting vegetation develops heat, making temperatures more difficult to control.

Another important factor to keep in mind is that as soon as the fruits or vegetables are harvested and have been sufficiently prepared for storage they should immediately be reduced to storage temperatures. At higher temperatures, vegetation ages more than at lower temperatures. Thus, if cooled immediately, the storage life of the product is prolonged.

#### Specific Storage Information

**Apples** – For best results, apples should be placed in storage at the proper maturity. This varies with varieties but as a general guide, most varieties are at the right stage when the ground colour shows the first sign of turning from green to yellow. Blushed apples should be at least moderately well coloured.

As a general precaution against superficial scald, all apples should be wrapped in oiled wrappers (odourless mineral oil 12-15 per cent oil by weight). If these wrappers are not available, ordinary tissue wraps help protect the fruit from bruising.

In selecting containers, well ventilated boxes are usually best. If these boxes are slatted, care should be taken to see that the spaces between slats are not so wide that the fruit can be jammed between and become damaged. Usually, a ¼ inch space between slats is sufficient to provide air circulation and also protect the fruit.

Varieties known to have a fairly long storage life should be used. Also, varieties which are harvested late in the season are more suitable for air-cooled storages. A later maturing variety is usually on the tree until weather conditions are such that fairly low temperatures can be obtained for cooling.

Most varieties are best stored at 0°C and 90 per cent relative humidity if harvested and handled under ideal conditions. This means plenty of moisture and cooling has to be employed. The critical factor to watch in these varieties is freezing – most types are safe from frost injury at -1°C or above.

Table 1 shows the best temperatures, humidities and approximate storage life under these conditions for some

of the more common varieties of apples. In most cellar storages, the storage life will be shorter than that shown because of the difficulty in obtaining ideal conditions.

**Pears** – The harvesting and handling of pears is very similar to apples. One exception is that they should be harvested in a less mature state. Most varieties should be harvested while still green or when they are what is known as the “white green” stage. When pears show sign of yellowing, their storage life is practically over and at this stage they should be ripened at a temperature of 16°C and high humidity for maximum flavour development. Further exposure at this maturity to low temperatures only results in breakdown and poor quality.

The storage temperature for pears is 0°C and 90 per cent relative humidity.

**Other Fruits** – Most other fruits, including berries and the stone fruits, are not usually considered suitable for storage. In any case, these usually ripen and are harvested during the warm weather when air-cooled storage is ineffective for producing low temperatures. However, the ventilated storage may be instrumental in prolonging the life of short-lived fruits for a day or so as compared with house temperatures.

Probably the chief function of the household storage will be for holding vegetables. Fortunately, vegetables can be stored in the house with less trouble and more success than fruits.

**Potatoes** – Potatoes should be allowed to mature properly before harvesting for best storage results. An indication of proper maturity is shown when the stalks become dry or withered. After digging, the tubers should be well dried. All damaged tubers should be rejected and the sound, healthy tubers can then be placed in storage.

Whether the potatoes are placed in bins, bags or boxes, the main consideration is air circulation. For this reason, a slatted box is usually best.

The storage atmosphere should be well moistened (90 per cent relative humidity) but it is not good practice to wet the surface of the potatoes. Storage temperatures should not be allowed to go below 3°C for table potatoes. Below this temperature, sweetening takes place, making the tubers undesirable. Quite often however, if the exposure to lower temperatures has not been too long or severe, the sweetness will disappear on exposure to ordinary room temperatures.

Exposure to light hastens sprouting and produces a green colour or sunburn, hence potatoes should be covered or shaded from light. As the storage season advances, potatoes should be examined from time to time and when sprouting is evident, the entire lot should be gone over, removing the sprouts and rejecting damaged or diseased tubers.

The storage life of potatoes if kept under the above recommended conditions should be five to six months.

Potatoes tend to taint other products in the same storage. Hence, fruits and dairy products may pick up a potato flavour or taint if they are held in the same storage room.

**Root Crops including Beets, Carrots, Parsnips, Turnips, and Rutabagas** – These crops, with minor exceptions, are treated alike with respect to harvest and storage. Beets should be harvested before there is danger of freezing. The other root crops can stand quite severe frosts in the field, particularly parsnips. All these crops should be allowed to remain in the ground until fully mature for best storage results.

In harvesting, these crops are either dug or pulled, as the occasion permits, as much of the soil is removed as possible without scratching or damaging them. The stalks are trimmed and the roots are then ready for storage. This operation can either be done by trimming with a knife or twisting by hand, whichever is more convenient.

In order to prevent wilting, root crops can be stored in dampened sand, peat or sphagnum moss. When sand is used, the vegetables are placed in a bin or box and the sand is added simultaneously so that all spaces are filled and there is a cover of sand on top (in other words, these vegetables are buried in sand). This sand is sprinkled with water from time to time just sufficient to keep the sand slightly damp.

When peat or moss is used, these should be dampened before packing. A satisfactory method is to place about two-thirds of the estimated amount on a concrete floor and tease it out so that there is no evidence of matting. Sprinkle this with water as it is turned over with a fork or rake until it has picked up water to the point where it can be squeezed out by hand pressure. This is too damp for the vegetables, so the remainder one-third of dry moss or peat is added and the whole thoroughly mixed. Alternate layers of this dampened material are added to the vegetables as they are packed in bins or boxes. The top surface may require a light sprinkle from time to time during storage.

The best storage conditions for these crops are 0°C and high relative humidity (95 per cent).

**Cabbages** – Cabbages should be well matured for good storage. Firm, heavy, solid heads are best. Danish Ballhead types of cabbage are better than the earlier maturing types. Care must be taken also in harvesting cabbages before they split and crack with excessive growth and over maturity.

Cabbages can be stored either with or without roots. If the root is removed, it can be cut off just a short distance from the head. In either case, the diseased or otherwise damaged leaves are removed. Cabbage heads should not be trimmed too closely. Healthy outside leaves provide protection against bruising in handling. If the roots are left on, the heads of cabbage can be planted in the storage chamber in moist soil. The roots should be moderately covered and the soil kept damp at all times. Care should be taken when damping down not to get the heads wet. If stored without the roots, the heads can be placed in bins, shelves, or boxes. In any method, care should be taken to see that the quantity stored together is such that ample air circulation is permitted.

The recommended temperature is 0°C with a high relative humidity (90-95 per cent). The storage life for good sound heads under these conditions is three to four months.

**Cauliflower** – Cauliflower kept under the best conditions has a storage life of only a few weeks. The leaves and roots should be removed in a similar manner to cabbage. The heads should be harvested when full and the head or curd is still white.

The best storage conditions are the same as for cabbage, namely, 0°C and 90 to 95 per cent relative humidity.

**Celery** – Celery is somewhat of a specialize crop from the cultural standpoint besides being rather a difficult product to store successfully. For these reasons, the householder should be well informed before attempting to grow or store celery.

When at the proper stage of maturity, it is found that larger heads are more satisfactory than loosely formed or smaller heads.

The outside damaged or diseased leaves should be removed at harvest. The heads should be packed tightly in boxes or crates with the roots still attached. If replanted, they are put in moistened soil or sand, similar to the method described for cabbage.

The recommended storage temperature is 0°C. High moisture conditions (90 per cent relative humidity) should be maintained to prevent wilting or toughening

of the stalks. On the other hand, excessive moisture is liable to cause rotting. The storage life under these conditions is three to four months at the most.

**Onions** – Onions are at their best stage for storage when fully mature. An indication of this is when the leaves have flattened and have become withered. The onions are then dug and allowed to dry in the sun. The bulbs should be frequently turned, particularly after rainy or damp weather. Damaged material should be rejected, including thick-necked specimens.

The best type of container is one which provides the most air circulation. For this purpose, shallow slatted trays or open mesh sacks are used. Exposure to light should be avoided as this induces sprouting. Frequent inspection and sprout removal should be done. The most important factor in onion storage is keeping them dry. For this reason, quite satisfactory results are often obtained by storing in the household cellar or basement as long as the temperature is not excessively high and the humidity is low. If a special storage is built for this crop, however, a temperature of 0°C and 70 per cent relative humidity (or lower) is ideal. The maximum storage life of onions is about six or seven months.

**Squash and Pumpkins** – These two vegetable crops are handled very much alike in storage. Pumpkins however, are shorter lived than squash, pumpkins lasting about two to three months and squash up to six months. Squash and pumpkins should be well matured at harvest. An indication of proper maturity is when the skin becomes hard and dry. At this time, tapping with the knuckles produces a dry hollow sound in contrast to soft pulpy sound when immature.

Pumpkins can be pulled from the vine, the stem separating with comparative ease. The stem of squash should be cut well back on the vine, leaving a fair amount attached to the squash itself.

Both squash and pumpkins have to be stored in a warm, dry place, 13° to 16°C and 70 to 75 per cent relative humidity. Thus, storing on racks in the attic or similar location is usually successful.

**Tomatoes** – These are usually short lived in storage under the best conditions are not successfully held for periods exceeding five weeks. Tomatoes must show signs of orange or red colour when picked to develop full flavour and quality afterwards. Furthermore, if they are not fully ripened at harvest, they must be exposed to temperatures over 13°C to ripen normally. If ripe, they can be held at 4°C, thus extending their storage life. The humidity at all times should be high (90 per cent relative humidity).

**TABLE 1**

Variety	Temperature (Celsius)	% Relative Humidity	End of Storage Life
Baldwin	0	90 or over	March
Ben Davis	0	90 or over	May
Cox Orange	2	95 or over	December
Delicious	0	90 or over	March
Snow	0	90 or over	December
Golden Russet	0	95 or over	May
Gravenstein	0	90 or over	November
Jonathan	0	90 or over	January
King	2	90 or over	January
McIntosh	0	90 or over	January
Newtown	1 – 2	90 or over	April
Rhode Island Greening	0	90 or over	February
Northern Spy	0	90 or over	April
Stark	0	90 or over	April

**SUMMARY CHART SHOWING THE TEMPERATURE AND HUMIDITY CONDITIONS FOR THE MORE COMMON FRUITS AND VEGETABLES FOR HOUSEHOLD STORAGE, ALONG WITH THE MORE IMPORTANT PRECAUTIONS TO BE TAKEN WITH THESE CROPS**

Product	Temperature (Celsius)	% Storage Humidity	Precautions
Apples	0	90	See exceptions for different varieties
Beets	0	95	Can be stored in moist sand
Cabbage	0	95	Planted in soil or bin storage
Carrots	0	95	Can be stored in moist sand
Cauliflower	0	95	Very short storage life
Celery	0	95	Very difficult to store
Onions	0 – 10	70	Must be keep very dry
Parsnips	0	95	Can be stored in moist sand
Potatoes	3 – 4	90	Avoid low temperature which cause sweetening, also watch tainting problem
Pumpkins	13 – 16	70	Keep dry
Squash	13 – 16	70	Keep dry
Tomatoes	13	90	Short storage life
Turnips	0	95	Can be stored in moist sand

**FOR FURTHER INFORMATION CONTACT**

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