



Punjab Horticultural Postharvest Technology Centre Punjab Agricultural University, Ludhiana

PHPTC Newsletter

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POSTHARVEST HANDLING OF WINTER SEASON VEGETABLES

With the advent of new technologies such as development of new hybrids, drip irrigation, fertigation, polynet house cultivation, plant protection measures, the area and production under vegetable crops in India has increased many folds. India ranks second in the world after China in vegetable production. However, the vegetables are highly perishable and significant amount of the produce gets spoiled during postharvest handling operations. This happens due to lack of awareness about the appropriate postharvest technologies and non availability of adequate postharvest infrastructure at farm and market level. Therefore, in order to reduce the postharvest losses, the knowledge of postharvest practices is very essential. Special tender care is needed during harvesting, handling, storage, transportation and marketing of vegetables. The various post harvest handling practices viz., precooling, cleaning, washing, sorting, grading, packaging and storage at low temperature are pre requisites to maintain the quality of vegetables. Besides post harvest practices the harvesting of perishable produce should be carried out with appropriate care to reduce bruises and injuries which deteriorate the quality afterwards.

Harvesting : Winter season vegetables like cauliflower, cabbage, tomato, capsicum, carrot and other leafy vegetables should be harvested with due care. To ensure good quality, these should be harvested at their proper maturity when they have attained their proper size. Some typical characteristics of maturity indices of winter vegetables are given below: -

Vegetables	Maturity indices
Cabbage	Fully developed heads but firm

Cauliflower	Compact, well developed curds at least (15 cm) in diameter.
Knol khol	Knobs light green tender 5-8 cm in diameter
Brussel sprouts	Buds should be firm but not overmature which is indicated by splitting of outer leaves, 2.5 to 5 cm in diameter
Broccoli	Adequate diameter, compact, all florets should be closed
Bellpepper	Fruits fully developed, still green and shining.
Potato	Yellowing and drying of haulms
Onion	Neck tissues begin to soften and tops are about to abscise and decolorize, 10-20% tops fall over
Garlic	Well filled bulbs, tops dry down
Garden pea	Early cultivars require 1000 heat units and late require more than 1600 heat units. Pods tender, filled, high sugar, change color from dark green to light green
Carrot	Marketable size with uniform taper
Radish/Turnip	When attained marketable size but before becoming pithy
Celery	Reaches marketable size and before outer petioles develop pithiness, 90 to 120 days after transplanting
Tomatoes	For local market harvest when red ripe, for medium distance markets at pink stage and for distant market at green ripe (seeds fully developed, gel

	formation advanced in at least one locule) breaker stage. For processing tomato should be harvested when fully red ripe.
Spinach	Adequate size (35-45 days after planting)

The harvesting of cauliflower, tomato, capsicum, carrot etc. should be done by using knives or clippers in a safe way with minimum injuries as these could not be cured latterly. For the harvesting of root vegetables like carrot, radish, turnip etc., the harvesters should hold the produce firmly but gently and pull upwards or dig gently by tools. Any mishandling in the diggings may lead to mechanical injury. To reduce crop losses, wearing cotton gloves, trimming fingernails and removing jewellery such as rings and bracelets can help in reducing mechanical damage during harvest. After harvesting cauliflower, tomato, capsicum etc. should not be packed in the gunny or nylon bags because they injure the vegetable by bruising. So, for safe harvesting, handling, transportation and marketing the plastic crates should be used.



Harvesting of Tomato

Precooling: Precooling is done to remove the field heat when crop is harvested during hot weather. It is done to reduce the rate of respiration and transpiration. The various methods of precooling are room cooling, forced air cooling, hydro

cooling and vacuum cooling. Farmers usually do precooling under shade because much cost is involved in other methods. Precooling helps to maintain the quality of crop. The other low cost technology which can be used by farmers is evaporative cooling and hydrocooling.

Curing: Curing of root or tuber crops like potato is essential immediately after harvesting. It helps to form new layer of protective cells over the wounds and injuries occurred during harvesting. In bulb crops like onion it is done to dry the outer layers of skin and neck tissues and prevent the decay during storage. At farm level curing is usually done in the field itself under partial shade when the weather is warm and dry.

Cleaning, washing and trimming: Vegetables like cauliflower, cabbage, carrot, radish, turnip etc should be trimmed or topped to remove inedible plant material or excess outer leaves. This work should be done in the field instead of the market because the leafy waste can be used as green manure and adds to the organic matter of the soil. This simple practice also helps to reduce the high rate of water loss, which occurs through the leaves of root and tuber crops. To improve the external appearance and market value, carrot, tomato and capsicum should be marketed after proper washing where as cabbage and cauliflower should never be washed.

Grading and Sorting: Vegetables can be graded on the basis of size, weight, colour, maturity etc and by doing this farmers could earn more profit. The grades for some winter vegetables are suggested by Directorate of Marketing and Inspection (DMI), Govt. of India which are as under : -

1. Cabbage

Size Code	Weight (in grams)
A	Below 250
B	251-500
C	501-750
D	750-1000
E	More than 1 kg

2. Cauliflower

Minimum diameter of equatorial section (in cm)	Arc measured on the largest dimension of upper part of inflorescence (in cm)
11	13

3. Brussel sprouts

Type of Brussel Sprout	Minimum diameter (in mm)
Trimmed (Extra Class, Class I and Class II)	10
Untrimmed (Extra Class and Class I)	15

4. Ware Potato

Size Code	Equatorial diameter (in mm)
A	18.1-28.0
B	28.1-45.0
C	45.1-65.0
D	65.1-80.0
E	More than 80

5. Garlic

Size Code	Minimum diameter of equatorial section (in mm)
Bulb with cloves	
Extra Class	45
Class I and Class II	30
Bulb without cloves	
Extra Class	20
Class I and Class II	15

6. Onion

Size Code	Diameter (in mm)
A	10-20
B	21-40
C	41-70
D	71 and above

7. Sweet pepper

Type of pepper	Shoulder diameter or width (not less than)
Elongated Sweet peppers	20 mm
Square Sweet peppers (blunt) or Square tapering Sweet peppers (pegtop)	40 mm
Flat Sweet peppers (tomato peppers)	55 mm

8. Carrot

- a. For early carrots/bunched carrots/small root varieties

Size Code	Diameter (in mm)	Weight (in grams)
A	10-20	8-20
B	21-30	21-80
C	31-40	81-100
D	41-45	101-110

- b. For topped or large root carrots

Size Code	Diameter (in mm)	Weight (in grams)
A	21-30	45-80
B	31-45	81-150
C	46 and above	151 and above

9. Ribbed Celery

Size Code	Weight (in grams)
A	150-500
B	501-800
C	Over 800

10. Tomatoes

Size Code	Minimum diameter (in mm)
1	30-34
2	35-39
3	40-46
4	47-56
5	57-66
6	67-81

7	82-101
8	102 and above

Vegetable growers should market their produce in local market by selecting at least three grades i.e. best quality, moderate and other. Adoption of this little intervention can help them bargain on the best and moderate quality batch and could earn more profit.



Grading of Pea



Grading of Potato

Packaging: Appearance plays a major role in vegetable sales success. Packaging of produce is essential to maintain quality and prevent deterioration. There is wide range of packaging materials like bamboo baskets, wooden boxes, gunny bags, fiberboard boxes, plastic trays/crates, molded pulp trays, etc. Gunny bags are generally used for potato, net bags are used for onion and garlic. Plastic crates are used for wide range of produce like tomato, cauliflower, cabbage etc in wholesale market. At retail level shrink and cling packaging is used to maintain the quality of crops like cabbage and capsicum.



Bulk packaging of Cauliflower



Shrink packaging of Capsicum

Storage: During peak winter season, the prices of vegetables crash due to glut in the market. To avoid this situation, storage of vegetables is a good option. However, the knowledge about storage requirement of produce viz. temperature and relative humidity is very important. The required storage conditions and storage period for winter vegetables are given below: -

Vegetables	Temp. (°C)	Relative Humidity (%)	Approx. Storage life
Cabbage (Early)	0-1	95-98	3-6 weeks
Cabbage (Late)	0-1	95-98	5-6 months
Cauliflower	0-1	95-98	3-4 weeks
Brussel sprout	0-1	95-98	3-5 weeks
Broccoli	0-1	95-98	10-14 days
Kale	0-1	95-98	2-3 weeks
Carrot (Immature roots)	0-1	95-98	4-6 weeks
Carrot (Mature roots)	0-1	95-98	7-9 months

Turnip	0-1	95	4-5 months
Radish	0-1	95	3-4 months
Garlic	0-1	65-70	6-7 months
Onion	0-1	65-70	6-9 months
Potato*(Ware potato)	10-12	90-95	5-6 months
Potato (seed)	0-3	90-95	5-6 months
Spinach	0-1	95-98	10-14 days
Celery	0-1	95-98	2-3 months
Pea	0-1	95-98	1-2 weeks
Bell pepper	7-8	90-95	3-5 weeks
Tomato (Mature green)	13-18	90-95	2-3 weeks
Tomato (Pink)	10-13	90-95	7-10 days
Tomato (Ripe)	7-10	90-95	3-5 days

*With CIPC application

After storage one should keep watch on the market prices and whenever there is a better price the produce should be marketed. Only those vegetables should be stored which are of good quality and are free from any disease, insect-pest and external injury. Carrot should never be washed and cauliflower, cabbage etc. should not be trimmed for storage.

Marketing: For successful retail marketing the vegetable growers need to prepare consumer packs of their produce. 250 g or 500 g capacity consumer packs of cauliflower and cabbage can be prepared very easily. Likewise leafy vegetables like spinach, coriander etc. can be bundled in 100 g or 250 g packs. For packaging films like cling, shrink and LDPE can be used. Cabbage, cauliflower, broccoli, bell pepper, tomato can be packed in cling or shrink films. Onion, potato, garlic etc can be packed in polynet bags. To reduce labour cost and for efficient packaging various type of packaging machines are also available in the market.

The farmers themselves can solve many market related problems by forming cooperative societies and can build up postharvest related infrastructure. The present situation demands such initiatives for strengthening retail marketing of vegetables at lucrative prices.

PHPTC Activities

- 1. Webinar on “Health Safe Ripening Techniques for Fruits”:** The Centre has conducted Webinar on “Health Safe Ripening Techniques for Fruits” on 14th September, 2020. About 60 participants attended the Webinar. In this webinar the participants were apprised about FSSAI approved ripening techniques of fruits. The harmful effects of calcium carbide in ripening of fruits were also discussed.
- 2. Training programme for Federation of Farmer Producer’s Organizations:** The Centre has conducted training for the group of farmers on “Postharvest Handling & Management of Fruits and Vegetables” on 19-10-2020. About 60 participants attended the training programme.





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List of tests and charges w.e.f. 01-04-2020

Instrument		Service(s)	Testing charges (Rs.)	
			Govt. Institutions / Farmers / Students	Private Institution / Industries
Water analysis				
For potability	i)	Microbiological analysis	100.00	200.00
	ii)	Biochemical and physical parameters (TDS, pH, color, odour)	100.00	200.00
Other parameters	i)	Microbiological analysis (detailed culture analysis)	300.00	500.00
	ii)	Total Hardness	100.00	200.00
	iii)	Chloride as Cl (mg/L)	100.00	200.00
	iv)	Free residual chlorine (mg/L)	100.00	200.00
General analysis				
Bio-chemicals tests of foods:	i)	Reducing sugar per sample	200.00	400.00
	ii)	Carotenoids per sample	200.00	400.00
	iii)	Chlorophyll per sample	200.00	400.00
	iv)	Vitamin C (ascorbic acid) per sample	100.00	200.00
	v)	Titrateable acidity per sample	50.00	100.00
	vi)	Limonin	200.00	400.00
	vii)	Total phenols	200.00	400.00
	viii)	Anthocyanin	200.00	400.00
	ix)	Antioxidant activity (DPPH)	200.00	400.00
Other services				
1	ICP-MS	Elements & heavy metals	400.00*	500.00**
2	UV-VIS spectrophotometer	Per reading (sample prepared by client, for research institutes only)	25.00	50.00
3	Water Activity Meter	Water activity per sample	50.00	100.00
4	Moisture Analyzer/ Hot Air Oven	Moisture/dry matter per sample	100.00	200.00
5	Refrigerated Centrifuge	Use per hour	100.00	200.00
6	Hand refractrometer	TSS per sample	15.00	25.00
7	pH meter	pH per sample	25.00	50.00
8	Conductivity meter	Conductivity per sample	25.00	50.00
9	Hot Air Drier	Use per day (8 hour)	200.00	500.00
10	Type I water	Per litre	10.00	10.00
11	Type II water	Per litre	5.00	5.00

* First three elements @ Rs. 400/- per element per sample. } Additional elements from the same

** First three elements @ Rs. 500/- per element per sample. } sample @ Rs. 200/- per element

Note : GST as applicable