Postharvest Handling of Horticultural Products: Keeping Principles in Perspective

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For all fresh produce, variety selection, climatic conditions and growing practices will greatly affect the quality at harvest. Successful marketing of fresh fruits and vegetables depends on maintaining the quality harvested. Fresh products are alive and respire (e.g. enzymatically converting sugars and acids in the presence of oxygen to carbon dioxide and heat). Careful postharvest handling aims to reduce the rate of respiration and the rate of other processes that cause deterioration and quality loss (water loss, many biochemical changes, softening, etc). Careful, clean, and efficient handling is more important than the sophistication of the postharvest equipment used.

Basic Postharvest Principles

Harvest at the optimum maturity for best eating quality. Immature products have higher postharvest water loss and shrivel during marketing. Harvesting fruits such as apples, tomatoes and melons too soon results in nonuniform ripening and poor flavor. Harvesting products overmature may cause toughness (asparagus, beans), rapid yellowing (cucumbers), undesirable starchiness (sweet corn) or other undesirable flavors (bitterness in lettuce), or short shelf-life (apples, peppers). Harvesting fruit vegetables too ripe (tomatoes) makes physical injury more likely and reduces shelf-life.

Harvest during the coolest part of the day. The product is coolest at sunrise, and harvesting when it is cool minimizes deterioration and water loss. It is easier and cheaper to keep a product cool then to cool a product that has heated up. To minimize the spread of disease, harvest should begin once the foliage has dried. Use clean harvest containers, cutting equipment and gloves. Keep harvested products out of the sun (use an empty container, shade cloth, or other protection) to avoid direct sun injury and unnecessary heating of the product.

Harvest and handle gently. Injured areas on products lead to increased postharvest decay and water loss. Cuts, punctures, abrasions, crushing and bruising all cause significant quality losses. In some cases, products may appear undamaged, but may be bruised internally (melons). Reduce physical damage by reducing the number of steps in which the product is directly handled. The ideal situation is to harvest and directly pack the product into the container in which the product will be marketed (strawberries is the classic example).

Pack carefully: do not overpack or underpack. Packing too tightly causes compression bruises; packing too

protect the product from high temperatures, high air velocities, and low relative humidity. Where appropriate, use shade, mist with clean water. Display products in their containers to reduce handling injury.

Ten Important Guidelines for Postharvest Handling in General:

1. MATURITY. Harvest the product at the correct stage of maturity.
2. REDUCE INJURIES. Reduce the physical handling to a minimum; every time the product is handled, it is damaged.
3. PROTECT PRODUCT. Protect the harvested product from the sun; bring it rapidly from the field/exposed area to the packing station and keep out of the direct sun. Transport carefully.
4. CLEANLINESS & SANITATION. Keep the packing line as simple as possible and keep it clean. If water is used, use clean water or a sanitizer if the water is reused. Maintain strict worker hygiene.
5. PACK CAREFULLY. Sort, classify and pack the product carefully to achieve uniformity and to prevent damage (compression, scrapes, etc.) which causes decay and inferior quality; use an adequate box or container. Packaging can also be informative.
6. PALLETIZE. Insure that the boxes are well placed on the pallet and that the pallet is strapped.
7. COOL. Cool the product as soon as possible after harvest; generally for every hour of delay from harvest to initiate cooling, one day of shelf-life is lost. Lowering product temperature is the most important way to reduce deterioration.
8. KNOW PRODUCT. Know the requirements of the market (size, ripeness, etc) and the product handling requirements (temp., RH, shelf-life, etc.) of the product.
9 COORDINATION. Always try to coordinate the postharvest handling so that it is efficient and rapid. Postharvest handling maintains the quality of a product, it can not improve it.
10. TRAINING. Train and compensate well the workers involved in critical postharvest handling steps; make sure that workers have the necessary tools to facilitate their work.

For Specialty Crops, Make Educated Guesses

When dealing with new crops and determining how they should be handled postharvest, one can make a few educated guesses based on the following questions:

1. Is the crop of tropical or temperate origin? This will likely indicate whether or not it is chilling sensitive.
2. Is the crop a leaf, root or fruit? This can help indicate how susceptible it is to water loss.
3. If the crop is a fruit, are there noticeable "ripening" changes after harvest? The degree of change after harvest is generally related to its rate of deterioration.
4. Are you harvesting the crop when it is rapidly growing or when it has completed its growth phase? Rapidly growing crops generally have very high respiration rates and high deterioration rates.
5. If the crop is a leafy product, are there rapid color changes? This may indicate how sensitive the deterioration process is and how sensitive it may be to exposure to the contaminant ethylene.
6. If the crop is a fruit, are there rapid textural and compositional (starch to sugar conversion) changes? This may indicate a "climateric" type fruit which would produce a lot of ethylene.
7. What are the postharvest characteristics of a related product (another species of the same genus, another genus of the same family, etc.)? Refer to the table for information on various products.
8. What is the estimated storage temperature? Try to place the product into one of the following categories:
   A. low temperature (32-41°F); B. moderate (41-50°F); C. moderately high (50-60°F)
9. What is the estimated shelf-life? Try to categorize into one of following categories:
   A. short shelf-life: 1-6 days
   B. moderate: 7-21 days
   C. long: 3-12 weeks or longer
10. Is the product very tender and delicate? Does it bruise easily? This will help to determine what an appropriate packaging system might be.

Examples of Postharvest Requirements for Selected Vegetables and Melons

Product	Harvest Quality	Storage °F	Storage % RH	Shelf-Life Days	Ethylene Sensitivity	Observations
Artichoke, globe	size, tender bracts	32	95	14	Low	sprinkle lightly
Asparagus	bracts at tip closed	36	95	14	Low	stand in water
Basil	fresh, tender leaves	55	95	7	Moderate	stand in water
Beans, Lima	seeds developed, plump	40	95	7	Moderate	sprinkle lightly
Beans, pole & snap	crisp pods, seeds immature	40	95	7	Moderate	sprinkle lightly
Beets, bunched	firm, deep red roots	32	95	14	Low	sprinkle, cut tops
Broccoli	firm head, buds not open	32	95	14-21	High	sprinkle; ice
Brussel sprouts	firm sprouts	32	95	21-28	High	sprinkle; ice
Cabbage	crisp, firm, compact head	32	95	30-180	High	sprinkle lightly
Cantaloupe Melons	stem separates; rind color	36	95	14	Moderate	ice
Carrots, topped						

Sources of Information on Postharvest Handling:

1. Cantwell, M. (compiler). 2003. **Fresh-cut Products: Maintaining Quality and Safety**. UC Davis Postharvest Horticulture Series No. 10. Binder of articles, bulletins, etc. for 3 day annual fresh-cut workshop. (UC