Angled luffa, bitter melon, fuzzy melon, yard-long bean...

Postharvest handling of Asian specialty vegetables under study

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The Asian specialty vegetables bitter melon, fuzzy melon, luffa and yard-long bean require good temperature management during postharvest handling to reduce deterioration and to avoid chilling injury. These vegetables can be successfully marketed for 1 to 2 weeks if kept at 10° to 12.5°C (50° to 55°F).

Expanding production of specialty vegetables in the United States during the last decade is a result of increased ethnic diversity in our population, renewed emphasis on eating healthy foods, and the successful promotion of greater variety in our diets. Many California-grown specialty vegetables marketed locally and regionally originated in subtropical or tropical areas and are sensitive to chilling, a characteristic that challenges distributors to maintain quality. Four specialty vegetables of Asian origin are considered here.

Angled luffa or Chinese okra (*Luffa acutangula*), a green-colored immature fruit with longitudinal ridges or ribs, is consumed much like summer squash. Mature fruits of a related species are used for their fibers, and are often called sponge gourds or luffas. The bitter melon, balsam pear or bitter gourd (*Momordica charantia*) is a white- to green-colored immature fruit with a warty appearance; as the name suggests, it is valued for its unique bitter flavor. Fuzzy melon or Chinese squash (*Benincasa hispida*) is an immature green-colored cylindrical fruit with many bristlelike trichomes, and is harvested and cooked lightly like summer squash. Fruits of some varieties may be left to mature to become the long-storing, edible "wax gourds." The yard-long bean or asparagus bean (*Vigna sesquipedalis*) is an immature legume pod, consumed much as green beans are, but having a richer flavor.

Our study sought to describe the postharvest characteristics of these four vegetables, to provide handling recommendations, and to emphasize postharvest changes that occur in all chilling-sensitive horticultural products.

Experiment sites and methods

The experimental materials were harvested at typical commercial maturity from small-scale vegetable farms near Davis and Stockton, California. They were transported at ambient temperature to the Mann Laboratory at UC Davis. On the same day the vegetables were selected for uniformity of size and freedom from defects, placed in glass containers kept at indicated temperatures and ventilated with humidified air at rates sufficient to maintain carbon dioxide levels at <0.5%. Respiration and ethylene production rates were determined from 1-ml gaseous samples analyzed on an infrared analyzer and a gas chromatograph equipped with a flame ionization detector, respectively (table 1). Each storage treatment consisted of three replications of three to five fruits, except for yard-long bean, which had 10 fruits per replicate.

The vegetables were evaluated for quality periodically during storage and after transfer from colder storage temperatures to 15°C (59°F) to simulate marketing conditions (table 2). Visual quality, seed development and other growth-related changes, color, chilling symptoms (pitting, surface discolorations), and decay were rated on a scale of 1 to 9, where 1 = minimum expression and 9 = maximum expression. For overall visual quality, a score of 5 indicated minimum commercial acceptability.

TABLE 1. Respiration rates of angled luffa, bitter melon, fuzzy melon and yard-long bean at indicated temperatures*

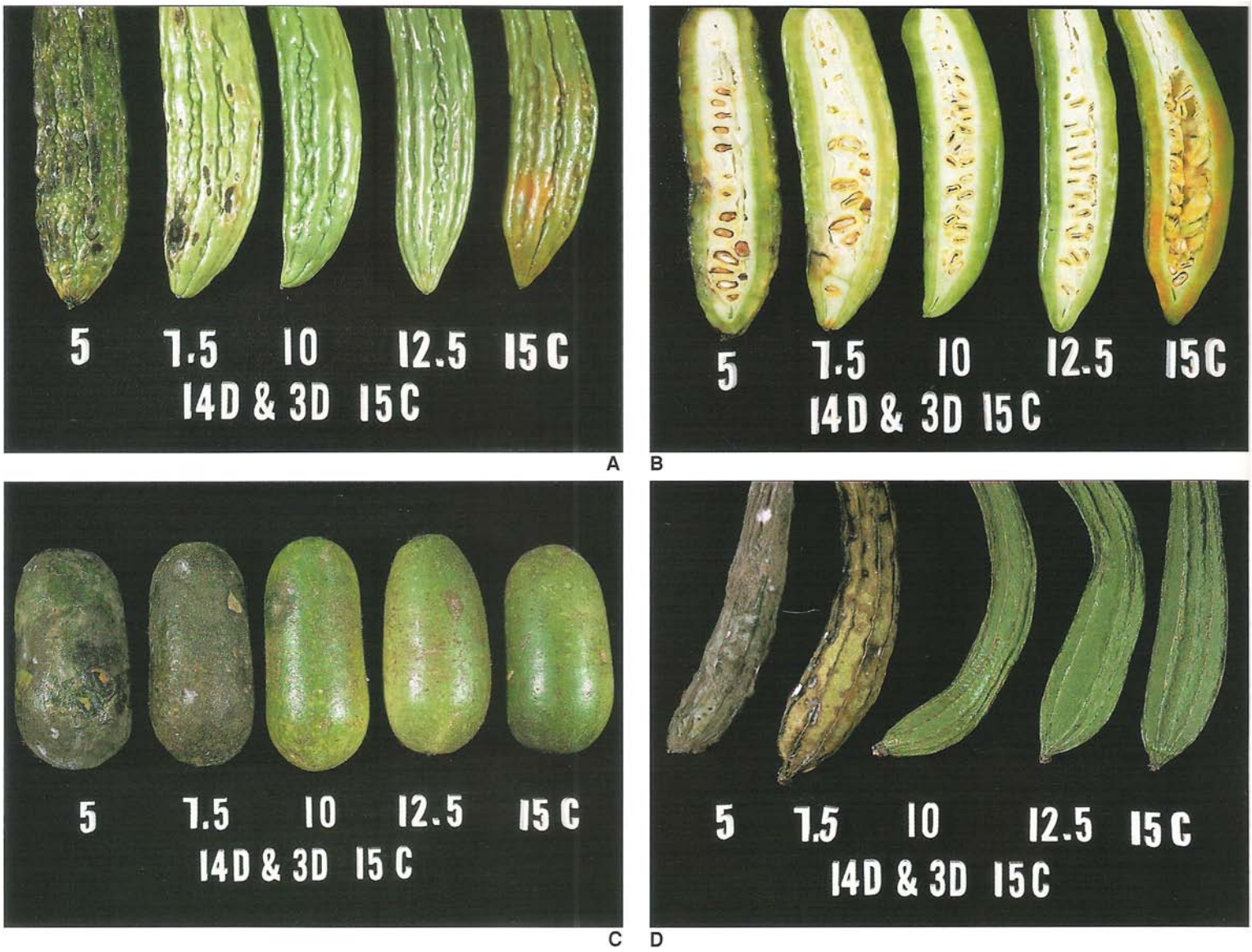
Temperature		Respiration rate			
		Angled luffa	Bitter melon	Fuzzy melon	Yard-long bean
°C	°F	ml CO_2/kg-h			
0	32	7	4	5	20
5	41	14	8	9	23
7.5	45	17	13	11	32
10	50	19	15	12	46
12.5	55	26	18	16	74
15	59	34	27	21	101
20	68	44	34	25	110

*Data are means from 18 fruits or 180 beans during the first 6 days of storage.

TABLE 2. Changes in visual quality scores of angled luffa, bitter melon, fuzzy melon and yard-long bean stored at indicated temperatures

Temperature		Visual quality score after indicated days*											
		Angled luffa			Bitter melon			Fuzzy melon			Yard-long bean		
		7	14	After transfer†	7	14	After transfer†	7	14	After transfer†	7	14	After transfer†
°C	°F												
0	32	9	3	nd‡	9	6	nd	9	6	nd	9	8	nd
5	41	9	4	1	9	7	1	9	3	1	9	6	1
7.5	45	nd	4	2	nd	3	1	nd	3	1	nd	4	1
10	50	9	6	5	9	7	4	9	6	2	9	5	2
12.5	55	nd	5	3	nd	8	4	nd	6	6	nd	4	2
15	59	8.4	5	4	9	6	2	8.7	7	7	8	2	1
20	68	7.3	3	1	7	3	1	9	6	nd	6	1	1

*Visual quality scored on a scale of 9 to 1 where 9 = excellent, 7 = good, 5 = fair (salable), 3 = poor (edible), 1 = inedible. Data are means from 9 fruits per evaluation.
†Three additional days at 15°C (59°F) after 14 days at the indicated temperatures.
‡nd = no data taken.



Visual quality of bitter melon (A and B), fuzzy melon (C) and angled luffa (D) after storage at different temperatures for 14 days. Fruits were evaluated 3 days after transfer to 15°C (59°F).

TABLE 3. Symptoms of chilling injury on angled luffa, bitter melon, fuzzy melon and yard-long bean

Commodity	Chilling symptoms during storage	After transfer to 15°C (59°F)
Angled luffa	Discoloration; watery black or brown spots on and under the skin	Serious black-colored rot
Bitter melon	Pitting; irregular 2 x 5-mm brown or black elongated spots	Increased decay
Fuzzy melon	Pitting; widely distributed tiny, colorless, sunken spots that can develop into larger, sunken brown spots	Darkening of external and internal tissue; watery breakdown; increased decay
Yard-long bean	Russeting; regularly distributed 1- to 2-mm, brown, elongated spots	Complete deterioration of affected tissue; tissue with water-soaked appearance; increased decay

TABLE 4. Postharvest quality defects, other than chilling injury, observed on angled luffa, bitter melon, fuzzy melon and yard-long bean

Commodity	Quality defects
Angled luffa	Damage to longitudinal ribs leads to water loss and decay Dehydration and toughening of peel Loss of green color Seed development
Bitter melon	Different stages of development at harvest Ripening and yellowing Scuffing of peel
Fuzzy melon	Sponginess due to dehydration Small brown pits due to damage from bristlelike trichomes Seed development Flavor changes (increase in sourness)
Yard-long bean	Rapid dehydration and loss of fresh appearance Yellowing Seed development Variation in stage of development at harvest

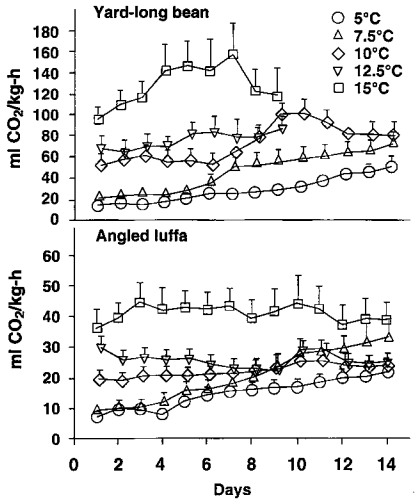


Fig. 1. Respiration rates (means and standard deviations) of yard-long bean (*top*) and angled luffa (*below*) stored at 5°C (41°F), 7.5°C (45°F), 10°C (50°F), 12.5°C (55°F), and 15°C (59°F).

Respiration/ethylene production

Respiration rates are highly correlated with the degree of perishability of a harvested product. Changes in the respiratory pattern after harvest are also associated with changes in composition and other qualities. Respiration rates of angled luffa, bitter melon and fuzzy melon were moderate (25 to 40 ml CO_2/ kg-h at 20°C = 68°F), and were comparable to those of slicing cucumbers but lower than those of summer squash. Respiration rates of yard-long beans were about four to five times higher than those of the cucurbit fruit vegetables, but were similar to rates of a similar product, snap beans.

Figure 1 shows how the respiration rate of yard-long beans and angled luffa changed during storage at five temperatures. Changes in respiration rates at 12.5°C (55°F) and 15°C (59°F) were associated with internal development. The continuous gradual increases in respiration rates at 5°C (41°F) and 7.5°C (45°F) indicated the onset of chilling injury.

These immature fruit vegetables produced little ethylene (<0.1 µl/kg-h at 20°C = 68°F) under normal conditions, but showed increases in "stress" ethylene when stored below 10°C (50°F). At higher temperatures (15°C = 59°F and 20°C = 68°F), yard-long beans, bitter melon and angled luffa showed internal growth changes often associated with temporary increases in ethylene production. For bitter melon, seed development was associated with other ripening-related changes, including external yellowing, internal red color development, and longitudinal splitting of the fruit. Exposure of these vegetables to ethylene at 20°C (68°F) greatly accelerated ripening and decay.

Changes after storage

Yard-long beans, it was found, can be stored successfully about 1 week, whereas angled luffa, bitter melon and fuzzy melon can be stored for about 2 weeks at 10° to 12.5°C (50° to 55°F). Quality evaluations after transfer from storage temperatures to 15°C (59°F) showed the chilling-sensitive nature of these commodities. Data for fuzzy melon (fig. 2) and the appearance of bitter melon, luffa and fuzzy melon clearly illustrate the effect of storage temperature on final quality. The most common symptoms of chilling injury and other postharvest defects (table 3) included brown or black surface discoloration, surface pitting and sunken areas and high levels of decay that began during storage and developed rapidly after transfer to warmer conditions.

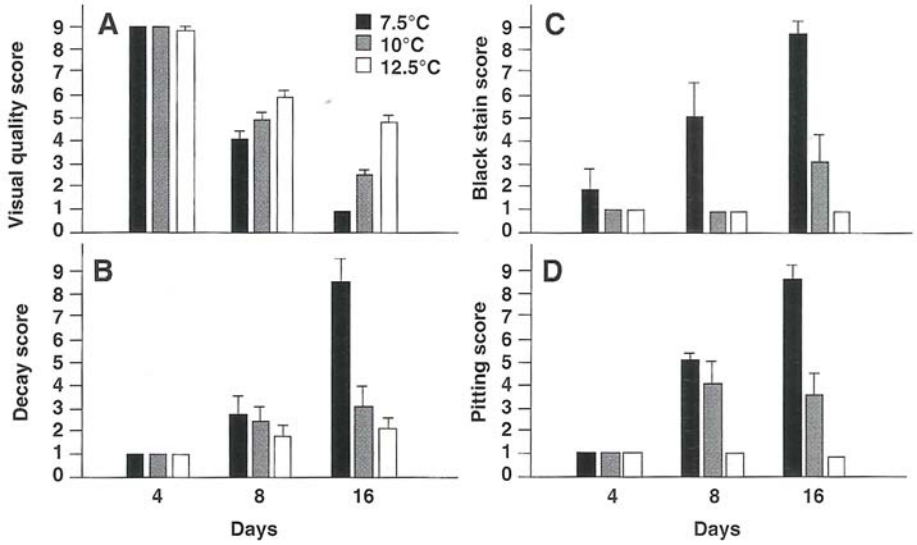


Fig. 2. Visual quality (A), decay (B), black stain (C) and pitting (D) scores (means and standard deviations) of fuzzy melon stored at 7.5°C (45°F), 10°C (50°F), and 12.5°C (55°F) for 12 days. Fruits were evaluated 3 days after transfer to 15°C (59°F).

Storage of bitter melon, yard-long bean and angled luffa at temperatures below 10°C (59°F) and fuzzy melon below 12.5°C (55°F) resulted in severe chilling injury within 14 days. Nonchilling-related quality defects that occurred during storage are summarized in table 4.

Yard-long beans are particularly problematic to handle because of their high respiration rate, high chilling sensitivity, and high rates of water loss and seed development at nonchilling temperatures. Yard-long beans are often iced commercially and marketed as quickly as possible. These conditions may cause chilling injury but greatly reduce deterioration due to water loss. They will retain good quality for up to 2 weeks if stored continuously at low temperatures, but they must be consumed immediately to avoid severe chilling symptoms. Storing yard-long beans at 10°C (59°F) provides a shelf life of <1 week.

Effect of maturity at harvest

Seed and fruit development after harvest affected the overall quality of these fruit-type vegetables. Postharvest developmental changes resulted in fruit splitting and ripening in bitter melon, pod swelling in yard-long beans, thinning of the edible flesh and development of a sour flavor in the fuzzy melon, and blossom-end enlargement, stem-end shrinkage and bitter flavor development in angled luffa. Bitter melon fruits harvested at the immature or green but fully developed (mature-green) stages were similar in quality when stored at 7.5°C (45°F) and 10°C (50°F). Fully developed fruits stored at 12.5°C (55°F) and 15°C (59°F), however, showed significantly more green color loss, decay and fruit splitting than did fruits harvested immature.

Conclusions

The vegetables bitter melon, angled luffa, fuzzy melon and yard-long beans are chilling sensitive and should not be stored below 10° to 12.5°C (50° to 55°F). Visual chilling symptoms were accentuated after transfer from storage temperatures to 15°C (59°F); they included pitted lesions, russeting, black and brown surface discolorations, and a high incidence of decay. Fruit development (seed development, color changes) continued during storage at temperatures >12.5°C (59°F). Respiration rates are high for yard-long bean, and moderate for fuzzy melon, bitter melon and angled luffa. These four fruit vegetables produce very little ethylene, but exposure to ethylene during postharvest handling accelerates color changes and reduces quality.

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