Storage of Kiwano (Horned melon) fruits

Marita Cantwell, Dept. Plant Sciences, University of California, Davis CA
20 Nov 1996, Research Summary, updated 25 July 2011

Introduction

The African horned melon (*Cucumis metuliferus*), also known as horned cucumber, kiwano and melano) is a cucurbit fruit with an yellow-orange exterior with thick blunt spines and a green, gelatinous pulp embedding the many seeds. It is endemic to semi-arid Africa (Bruecher, 1977; National Research Council, 2008). It is a specialty fresh produce item in the U.S. and is considered a "new crop plant" (Benzioni et al., 1993).

For marketing in the U.S, desirable characteristics for kiwanos include a size of about 250 g, a uniform yellow-orange exterior color, and a well developed and flavorful pulp. They are packed in single layer trays with shredded paper to protect the blunt spines. Postharvest losses due to spine punctures are common and the fruit are typically repacked during distribution. The pulp has a mild sweet-acid flavor, but the fruit often have a poor, insipid flavor. For the kiwano to have an adequate flavor, the fruit need to be harvested after the initiation of ripening or color change. The fruit's main attraction in the U.S. market is its unique external appearance and color.

The stage of maturity at harvest is considered critical for an adequate eating quality and postharvest shelf-life (Mendlinger et al., 1992). Sugars rapidly accumulate in the fruit during the last 10 days of development and ripening. The kiwano is very chilling sensitive. Fruit stored at 12°C or lower suffered high losses within 30 days. Fruits were stored for 3 months at 20 and 24°C with 30% and 0% decay, respectively (Benzioni et al., 1993). Growers in California store the fruit in buildings at ambient conditions and hope to achieve up to 6 months shelf-life. The kiwano responds to ethylene, and a postharvest treatment of ethylene just before marketing can improve the external color (Benzioni et al., 1993).

The objective of this study was to verify the storage temperatures and benefits of ethylene for California produced kiwano fruits.

Experimental

Fruits (unknown seed source) at various stages of ripeness were provided by 2 growers in different years. In both cases, fruits were grown with furrow irrigation and harvested in October. For evaluation of ethylene benefits, fruit (medium size, average 185 g) were harvested at the following stages: 1) green with <10% yellow, 2) green-yellow (more green than yellow), 3) yellow-green (more yellow than green) and 4) ripe, yellow to yellow-orange. Fruits at ripeness stages 1, 2 and 3 were stored in air at 20° or 30°C or 60 ppm ethylene for 6 days at 20°C. Other fruits were stored at 12.5°C or 5°C in commercial packaging for 2 months. In 1995, large ripe high quality fruit (stage 4, average weight 325 g) were provided by a grower to evaluate long-term storage temperatures. Fruit were individually wrapped in newspaper and stored in tomato cartons at 10, 12.5 and 15°C. The relative humidity conditions were 80-90%, 70-85% and 60-75%, respectively. Fruit were evaluated after 2 and 5 months storage. Fruit were evaluated for color (descriptive), firmness (scale of 3 to 1, where 3=firm, does not give to finger pressure,

2=moderately firm, gives slightly with 2 point pressure, 1=soft, gives easily with finger pressure), overall visual quality (5 to 1 scale, where 5=excellent, 4=good, 3=fair, 2=poor, 1=unusable), decay (1 to 5 scale, where 1=none, 2=slight, 3=moderate, 4=moderately severe and 5=severe), and composition (soluble solids and pH read on a homogenate of the pulp).

Results

Effect of ethylene treatment**.** Ethylene stimulated color development and advanced the color of green-yellow fruit to orange with a 6 day ethylene treatment + 8 days at 20°C (**Figure 1**). However, under these conditions, the ethylene treated fruit were very soft to finger pressure. The ethylene treatment also resulted in a loss of the internal structure, with the gelatinous pulp becoming liquified (Figure 1). The 30°C 6 day storage also increased color development and caused some breakdown of the internal pulp structure, but not to the degree that the ethylene treatment did. An ethylene treatment with a lower concentration or a shorter period of exposure may be adequate for color change without causing these detrimental effects. Mendlinger et al. (1992) applied 160 ppm for 24 hour, conditions more similar to those used for degreening honeydew melons.

Evaluation of storage temperatures. Storage at 5°C resulted in severe chilling injury, mostly decay within about 14 days. The fruit stored at 12.5°C began to decay within about 2 months. At that temperature, the fruit showed no important color change. In the second storage test, ripe high quality fruits (**Table 1**) were stored at 10°, 12.5° or 15°C. After 2 months, all the fruit stored at 10°C had severe decay (**Table 2**), with white (perhaps *Fusarium*) and black (probably *Alternaria*) molds being most prevalent (**Figure 3**). After 2 months, some decay began to appear on the kiwano stored at 12.5°C (Table 2). After 5 months, all fruit at 12.5°C had decayed with the same white and black molds being present with the addition of a gray mold (**Table 3**). The kiwano stored at 15°C were in excellent condition with no trace of decay (Table 3). The average weight loss over the 5 month period was 6.1 $\pm$ 0.4%. The fruit softened during the 5 month storage at 15°C. The initial firmness score was 2.9 (firm) and the final score was 1.5 (soft). During that period the external color had changed so that there was no trace of green. The yellow-orange did not appear to be more intense than when the fruit went into storage. After the 5 month storage, the average soluble solids content of the fruit was 5.8% with a pH of 4.38 (**Table 4**). Mendlinger et al. (1992) reported a soluble solids content of 6.2 and a pH of 4.24 for yellow-orange fruit before storage.

References

Benzioni, A., S. Mendlinger, M. Ventura and S. Huyskens. 1993 Germination, fruit development, yield, and postharvest characteristics of *Cucumis metuliferus*. In: J. Janick and J. E.Simon (eds.) New Crops, John Wiley and Sons, New York. pp. 553-557.

Bruecher, H. 1977. Cucurbitaceae, p. 258-297. In: Tropische Nutzpflanzen. Springer Verlag, Berlin.

Mendlinger, S., A. Benzioni, S. Huyskens and M. Ventura. 1992. Fruit development and postharvest physiology of *Cucumis metuliferus* Mey., a new crop plant. J. Hort. Sci. 67: 489-493.

National Research Council**.** 2008. Horned melon, p. 89–101. Lost Crops of Africa. Vol. III: Fruits. The National Academic Press, Washington DC.

Table 1. Initial quality of kiwano evaluated 2 days after harvest.

Initial Evaluation Oct 14, 1995	fruit number	Color	Firmness Score[1]	Overall Visual Quality[2]	Decay[3]
Group 1	1	green-yellow-orange	2.5	5	1
	2	green-yellow-orange	2	5	1
	3	green-yellow-orange	2	5	1
	4	mostly orange	1.5	5	1
Group 2	5	green-yellow-orange	2.5	5	1
	6	green-yellow-orange	2.5	5	1
	7	yellow-orange	2	5	1
	8	yellow-orange	2	5	1
Group 3	9	green-yellow	2.5	5	1
	10	green-yellow-orange	3	5	1
	11	green-yellow-orange	2.5	5	1
	12	yellow-orange	3	5	1

[1] Firmness scored on a 3 to 1 scale, where 3=firm, 2=moderately firm (gives slightly with finger pressure), and 1=soft.

[2] Visual quality scored on a 5 to 1 scale, where 5=excellent, 4=good, 3=fair (minimum of salability), 2=poor and 1=garbage

[3] Decay scored on a 1 to 5 scale, where 1=none, 2=slight, 3=moderate, 4=moderately sever, 5=severe

Table 2. Quality of kiwano described in Table 1 after storage for 2 months.

2 month Evaluation Dec 17, 1995	fruit number	Color	Firmness Score[1]	Overall Visual Quality[2]	Decay[3]	Observations
10°C (50°F)	1	yellow-orange	1	1	5	white mold on stem; black mold on spines
	2	translucent brownish	--	1	5	like bag of water
	3	yellow-orange	1	5	5	white and black molds on spines
	4	orange	1	5	4	one decay spot 3 cm diam.
12.5°C (55°F)	5	orange	2	5	1	
	6	yellow-orange	2.5	5	1	
	7	yellow-orange	1.5	5	3	two small decayed areas
	8	yellow-orange	2.5	5	1	
15°C (59°F)	9	yellow-orange	2.5	5	1	
	10	yellow-slight orange	3	5	1	
	11	yellow-orange	3	5	1	
	12	yellow-orange	3	5	1	

[1] Firmness scored on a 3 to 1 scale, where 3=firm, 2=moderately firm (gives slightly with finger pressure), and 1=soft.

[2] Visual quality scored on a 5 to 1 scale, where 5=excellent, 4=good, 3=fair (minimum of salability), 2=poor and 1=garbage

[3] Decay scored on a 1 to 5 scale, where 1=none, 2=slight, 3=moderate, 4=moderately sever, 5=severe

Table 3. Quality evaluation of kiwano after storage for 5 months at 12.5 or 15°C

	fruit number	Color	Firmness Score[1]	Overall Visual Quality[2]	Decay[3]	Observations
12.5°C (55°F)	5	--	--	1	5	all completely decayed;
	6	--	--	1	5	white, gray, black molds
	7	--	--	1	5	
	8	--	--	1	5	
15°C (59°F)	9	yellow-orange	2	5	1	not a trace of decay on
	10	yellow-orange	2	5	1	any fruits
	11	yellow-orange	1	5	1	
	12	yellow-orange	1	5	1	

[1] Firmness scored on a 3 to 1 scale, where 3=firm, 2=moderately firm (gives slightly with finger pressure), and 1=soft.

[2] Visual quality scored on a 5 to 1 scale, where 5=excellent, 4=good, 3=fair (minimum of salability), 2=poor and 1=garbage

[3] Decay scored on a 1 to 5 scale, where 1=none, 2=slight, 3=moderate, 4=moderately sever, 5=severe

Table 4. Soluble solids content and pH of the pulp of kiwano stored 5 months at 15°C (59°F). Pulp and seeds were ground lightly in blender, let stand and clear aliquots taken for direct reading of S.S. on a refractometer and pH by a pH meter.

Fruit number	% soluble solids	pH
9	5.7	4.35
10	5.7	4.35
11	5.9	4.41
12	5.9	4.43
Average	**5.8**	**4.38**

Figure 1. External and internal appearance of kiwano (commercial maturity) treated with ethylene (60ppm) for 6 days at 20°C + 8 days in air at 20°C (fruit on left). Middle and right fruit were held at 30 and 20°C in air during 14 days for comparison.

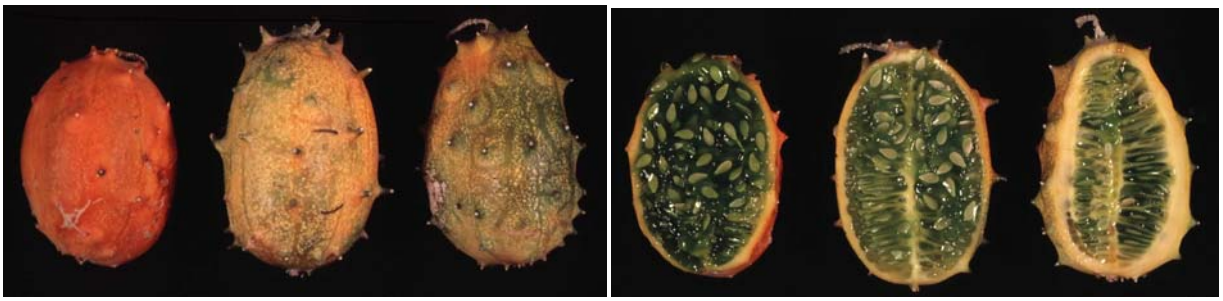

Figure 2. Typical decay symptoms on kiwano fruit stored at 10°C (50°F) for 2 months.

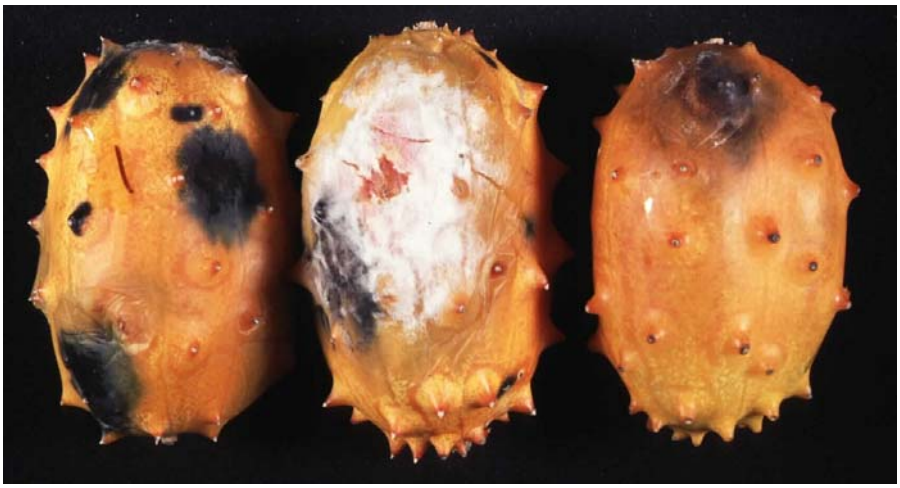

Figure 3. Appearance of kiwano stored for 5 months at 15°C (59°F) and 12.5°C (55°F). All fruit at 12.5°C had decayed.