

Overview Melon Quality & Postharvest Handling



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MELON COLOR

Color due to pigments

Orange-flesh fruit: carotenoids, especially beta-carotene (85%)

Green-flesh fruit: chlorophyll & low content of carotenoids

Pigment content determined at harvest

Color measurement: extraction of pigments or by color meters



Reflectance
Colorimeter

L^* = Lightness/darkness

Chroma = intensity, brightness

Hue = true "color"

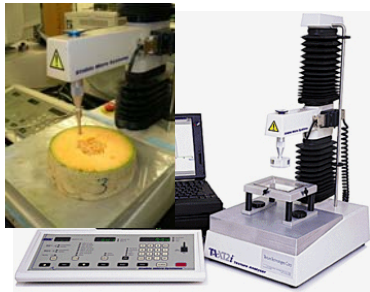


Example of a reflectance colorimeter
Values define a point in a 3-D color space

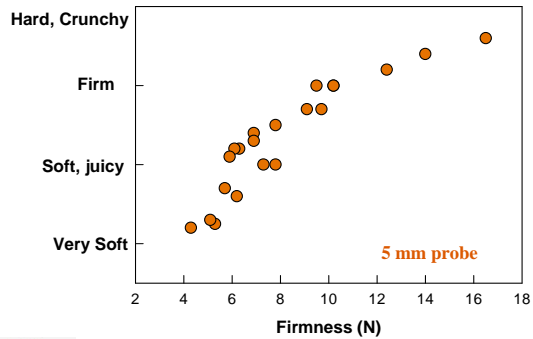
Melon Texture Force to Rupture

probe shape
probe diameter

Units of force
N=Newtons
1 N= 9.81 kilogram-force
1 N= 4.45 pound-force



Cantaloupe Melon Firmness and Sensory Texture



- Rupture force related to whole fruit nondestructive compression firmness
- Postharvest/postcutting changes:
 - inconsistent among melon varieties
 - variable, gradient within a fruit

Sugar Measurement

- Destructive
 - % SS
 - Total sugars by colorimetry
 - HPLC for individual sugars
- Nondestructive
 - Infrared on-line analysis



Concentration gradients

Temperature compensated refractometer
Digital readout eliminates errors



MELON FLAVOR

- **Sugars (>50% sucrose, 20% glucose, 26% fructose)**
 - At harvest, % soluble solids correlates well with extracted sugars
 - For good flavor:
 - Cantaloupe 10% & Honeydew 11-12% SS
 - Sugar content determined at harvest

- **Acids**
 - <0.1%, important for good flavor?

- **Aroma volatiles**
 - specific compounds for characteristic aromas/flavors

Melon Quality Attributes

- **Flavor**
- **Color**
- **Texture**



These quality attributes may vary due to: varieties, growing conditions, season, maturity at harvest, number of harvests, harvest & handling, storage conditions and period.....

Focus on maturity/ripeness at harvest since this continues to be problematic



USDA Inspector coring melons to check SS

“Leaves the rag”

July 2004

Cantaloupe Maturity/Ripeness

- • Fruit begins to separate from stem
 - abscission zone; “slip”
- External color between net
- Net well developed with wax
- Subtending leaf dries up
- Internal color, firmness, soluble solids

The “slip” is a very useful attribute & applicable to old & new cantaloupe varieties



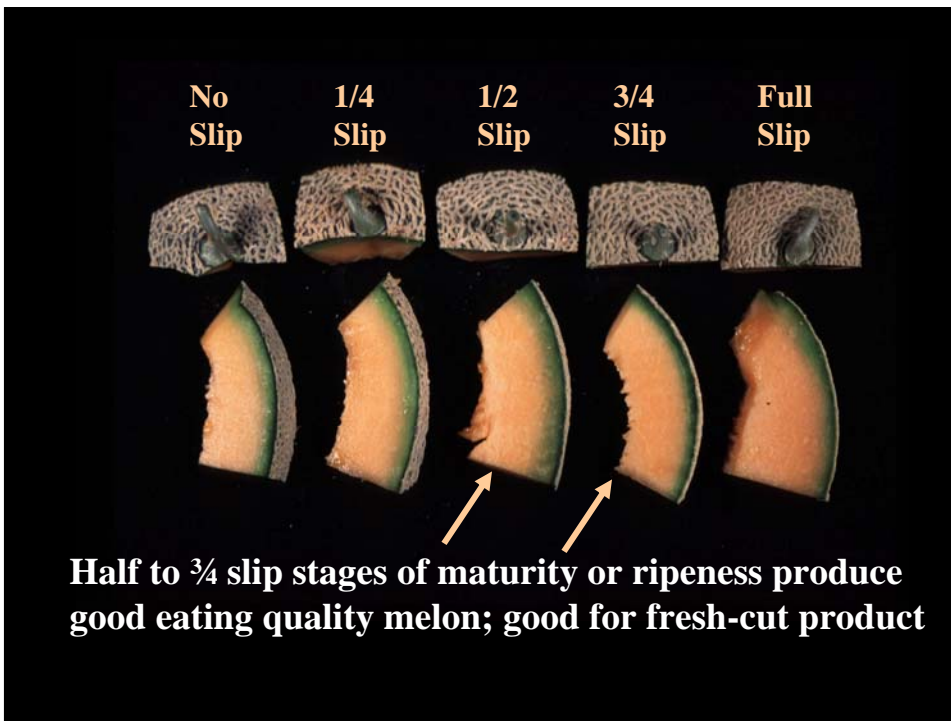


Table 1. Evaluations at harvest of 4 varieties harvested at 2 stages of maturity. Data are averages of 4 fruit per stage. (2003)

Variety	Maturity	Weight, g	External Color score	Internal ethylene (ppm)	Texture, N-force, 5mm probe	Soluble Solids, %
Sandstone "Expt."	¼-pull	1810	1	0.97	17.4	7.8
	Full slip, pull	1578	4.2	6.73	11.3	11.6
Impact	¼-pull	1875	1	1.93	9.3	9.4
	Full slip, pull	1728	3.8	20.83	5.2	11.2
Western Express	¼-pull	1915	1	1.45	12.0	9.7
	Full slip, pull	1850	4	17.42	8.0	11.1
Ocotillo	¼-pull	1581	1	1.91	12.5	8.1
	Full slip, pull	1674	3.8	11.49	12.0	10.6
LSD.05		ns	0.7	5.5	2.0	1.5

Characterization of cantaloupe melons (cv. Laredo) harvested at 2 maturity stages. Data are averages of 12 melons per stage.

Attribute	½ slip	Full slip, hard ripe	LSD.05
Weight (g)	1367	1398	ns
External color score ¹	2.8	3.3	ns
Internal CO ₂ (%)	1.02	1.08	ns
Internal ethylene (ppm)	2.42	4.24	0.7
Internal color (chroma)	35.2	35.4	ns
Pulp firmness (N-f, 5mm probe)	12.7	13.1	ns
Soluble solids (%)	12.5	12.2	ns

¹ external color score 1=green, 2=slight yellow, mostly green, 3=yellow-green, 4=greenish yellow 5=yellow or yellow-orange

Melon Maturity & Quality Factors

- External Color
- Firmness (blossom end)
- Surface hairs, smoothness, wax
- Aroma
- Internal cavity condition
- Pulp color and firmness
- Sugar content (soluble solids)
- Aroma and flavor



Honeydew and Orange Flesh Melons Maturity and Ripeness Classes

- Class 0: **Immature**
- Class 1: **Mature, but Unripe**
Ground color greenish-white; peel fuzzy; no aroma; 10% soluble solids; flesh crisp, melon splits when cut; minimum commercial harvest maturity
- Class 2: **Mature, Ripening** ← **Fresh-cut**
Ground color white; begins to develop surface wax; pulp crisp, melon splits

Maturity and Ripeness Classes for Honeydew melons

Class	Int. C ₂ H ₄ , ppm	Pulp firm., kg-f	Sol. solids, %
0 = Immature	<0.2	3.8	<10
1 = Mature, Unripe	0.8	3.1	10
2 = Mature, Ripening	5.2	2.1	11-12
3 = Ripe	27.1	1.5	12-14
4 = Overripe	29.4	1.1	14-15

firmness: 1.1 cm probe

(average 4 cultivars; Cantwell, unpublished)

Honeydew Melons

Fruit Characteristics at 4 Stages of Ripeness

Stage Ripeness	Internal C ₂ H ₄ ppm	Soluble Solids %	Firmness* Newtons	Firmness* Pounds
0	0.6	9.0	42	9.4
1 ♣	2.4	10.8	38	8.6
2 ♣	4.0	12.4	38	8.5
3	16.3	12.3	25	5.7

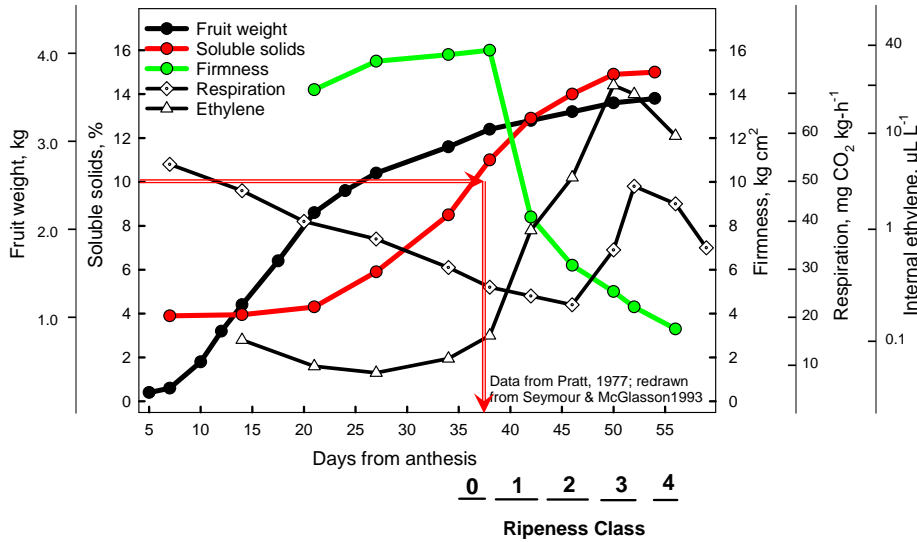
cv. Morning Ice

♣ = typical commercial maturity

* Maximum rupture force with 8 mm probe

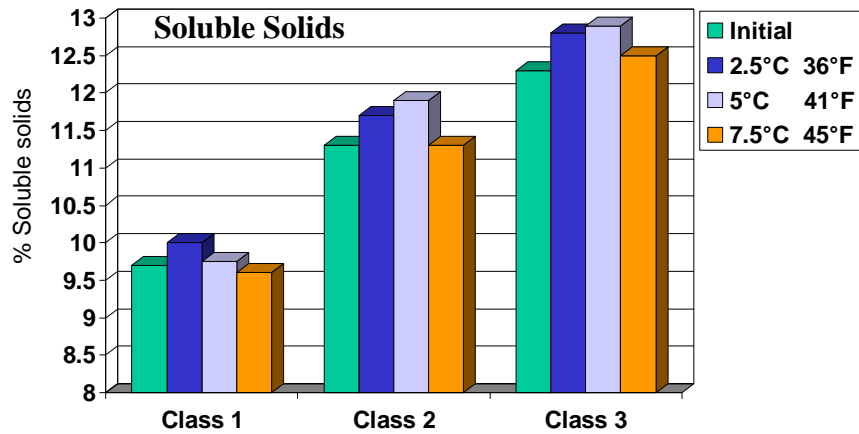
Cantwell & Suslow, UC Davis, 1999

Development & Ripening of Honeydew Melons Harvested at Different Stages



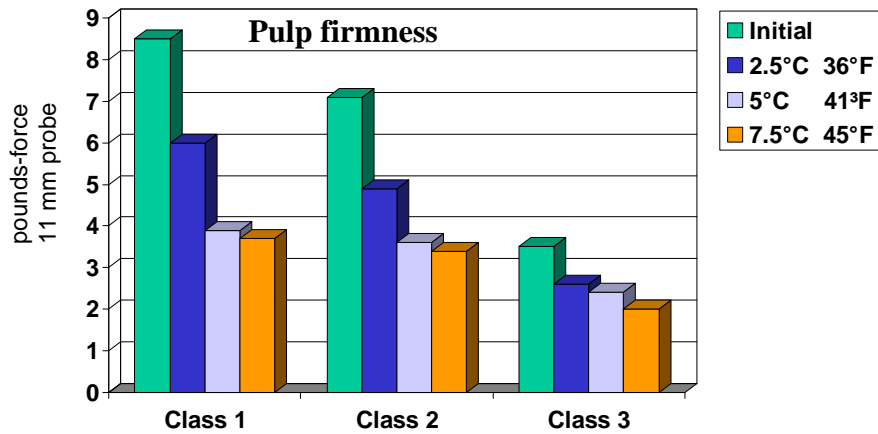
Honeydew melons: Soluble Solids

Fruits of different ripeness classes stored 18 days plus 3 days at 20°C (68°F)

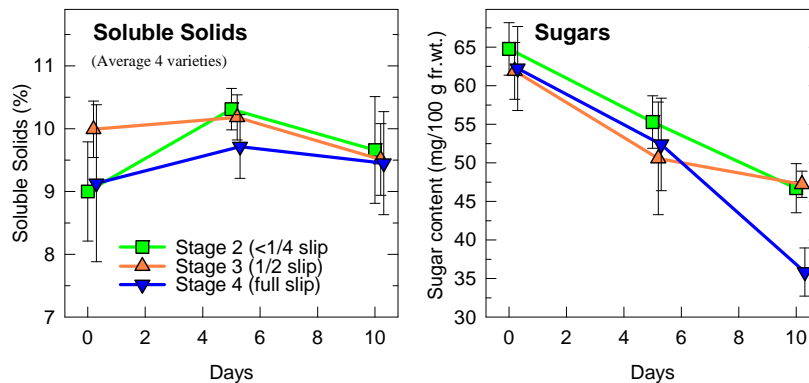


Honeydew melons: Pulp Firmness

Fruits of different ripeness classes
stored 18 days plus 3 days at 20°C (68°F)



Sugar loss in fresh-cut cantaloupe may be considerable, but Soluble solids do not change much; Sugar loss typically is not as extreme as in this example.



Typical loss over 10 days at 5°C (41°F):

S.S. 0-10%
Sugars 10-20%

External and internal appearance of Galia melons (cv. Deneb) harvested at 3 stages of maturity (California, 2003).



1 2 3
Maturity/Ripeness Stage

% Soluble solids

Stage 1 = 9.3
2 = 10.4
3 = 10.2

Aroma score

Stage 1 = 2.8
2 = 4.2
3 = 5.0

Pulp firmness

Stage 1 = 26.9 N
2 = 27.2
3 = 10.0

Internal Ethylene

Stage 1 = 0.2 ppm
2 = 0.8
3 = 1.1

Blossom end



Stem end



Equatorial peel

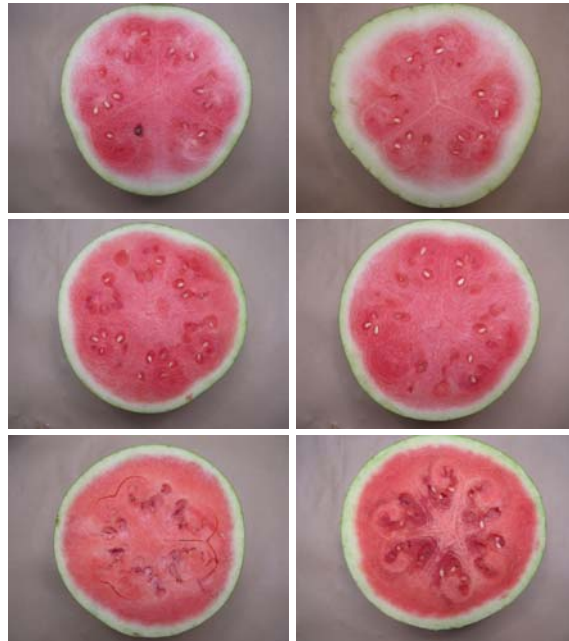


Equatorial slice



Tuscan Style Cantaloupes

Fruit	Int C ₂ H ₄ ppm	Ext Hue	Int Hue	Firmness N-f	Soluble Solids %
A	10.6	114.0	71.7	25.6	11.8
B	21.9	111.5	71.5	22.2	12.2
C	42.8	105.4	72.2	15.6	10.8
D	49.1	103.9	71.3	12.9	12.9



Internal appearance of **immature** cv. Tri-X 313 Watermelon.

Internal appearance of **mature** cv. Tri-X 313 Watermelon.

Internal appearance of **overmature** or **ethylene exposed** cv. Tri-X 313 Watermelon.

Melon Storage Conditions

- **Cantaloupes**

- 2.5°C (36°F), 90-95% RH
- 3-5% Oxygen + 10-15% carbon dioxide
- 2-4 weeks

- **Honeydew, Specialty Melons**

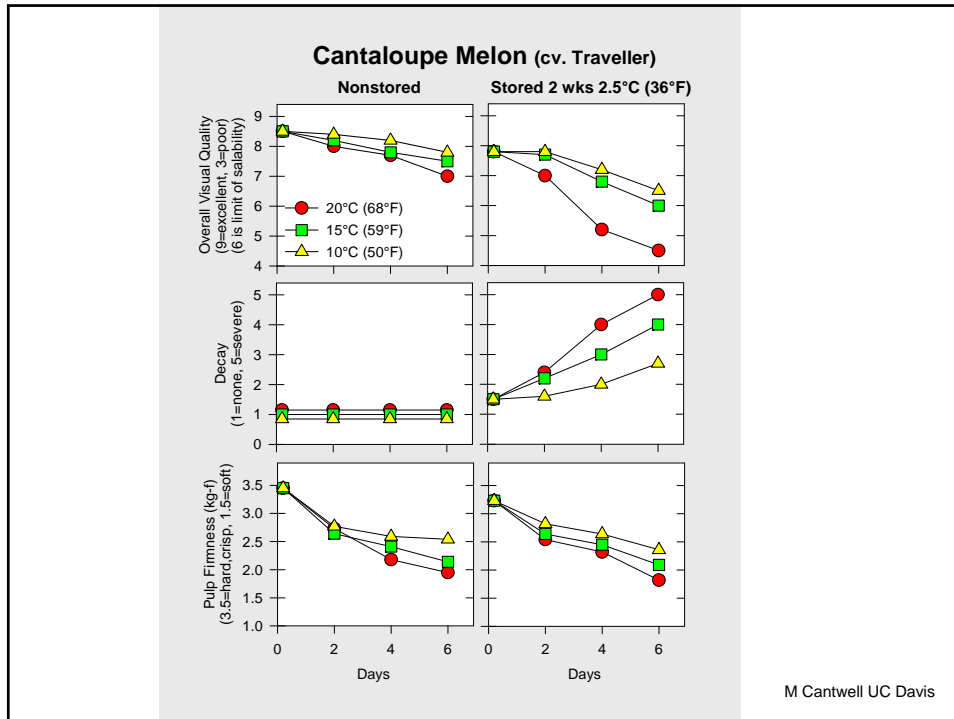
- 5 to 15°C (41 to 59°F), 80-90% RH
- optimum temperature depends on ripeness
- 2-6 weeks

Galia melons (cv Deneb) stored 4 weeks at 10°C (upper) or 7.5°C (lower) and then after transferred to 20°C for 2 days.

10°C
50°F

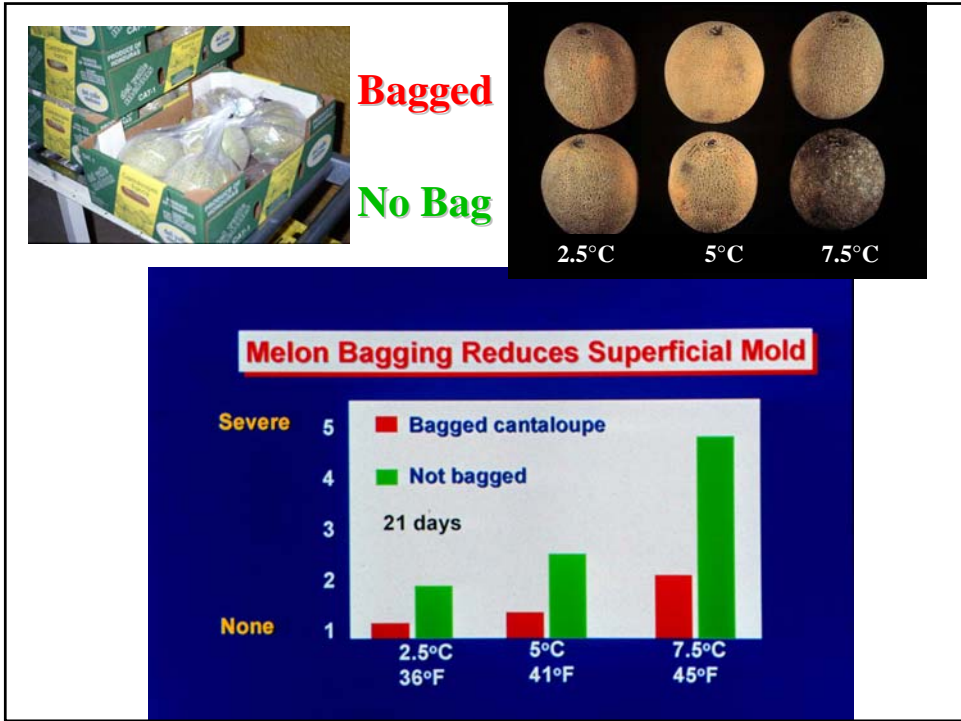


7.5°C
45°F



Decay Control: Cantaloupe

- Minimize physical injury
- Storage temperature: 2-3°C (34-36°F)
- Chlorinated water wash (100 ppm)
- Fungicide in wax
- Hot water dip (135°F for 3 min)
- High CO₂ concentrations (10-15%)

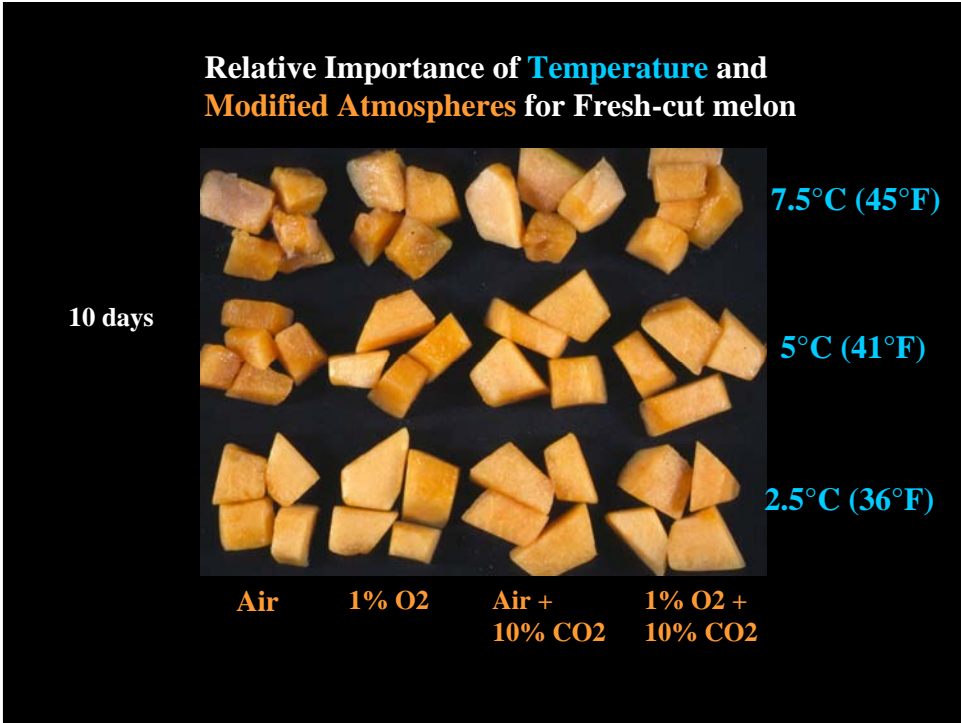


MA-stored cantaloupe; Bag in Box

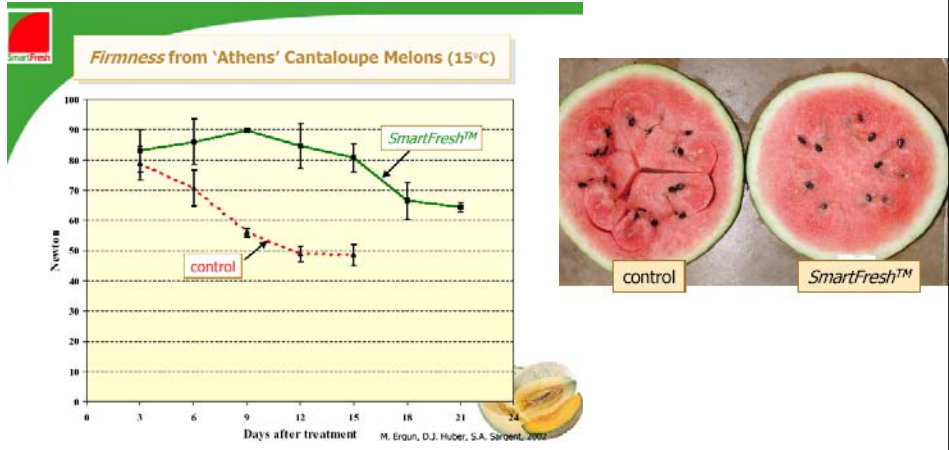


Open bag to de-gas
Allow time (2-3 days, ambient) to change color, improve aroma

Relative Importance of Temperature and Modified Atmospheres for Fresh-cut melon



1-MCP and melons
Efficacy depends on the melon type



(From Tony Beltran/Rodrigo Cifuentes talk at IFPA, April 2004)

Mini watermelons: Example of storage changes in 2 cultivars, 2003.

Cultivar	Treatment	Firmness N force (8mm probe)	Soluble solids, %
RWT 8149	At harvest	7.9	12.8
	2 weeks 10C air	6.5	11.3
	1-MCP + 2 weeks 10C Air	7.7	11.1
Extazy	At harvest	16.2	10.2
	2 weeks 10C air	8.9	10.5
	1-MCP + 2 weeks 10C Air	13.4	10.1
LSD.05		2.3	0.8

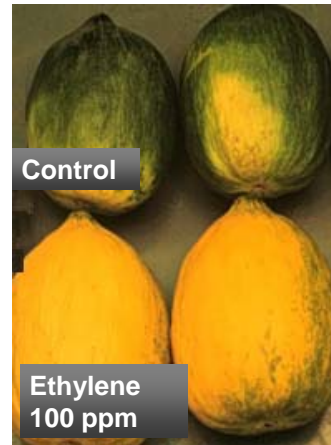
Data are averages of 6 fruit per treatment. 1-MCP application, 12h 500ppb at 10°C.
Fruit were not exposed to ethylene during storage.

Ripening Melons

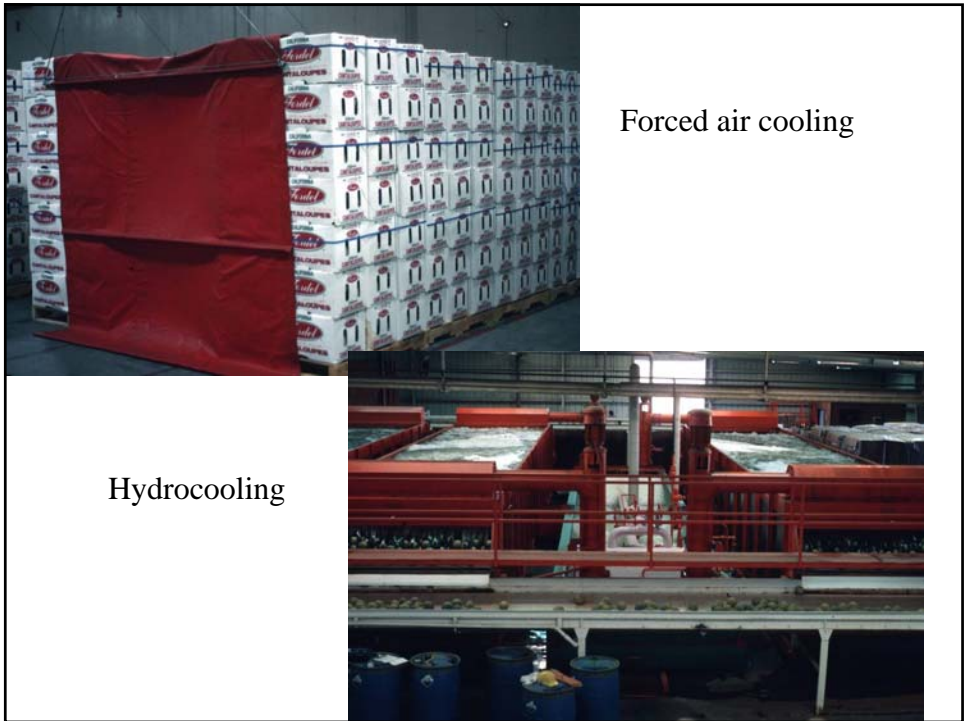
- **Initial Maturity/ripeness**
- **Temperature**
- **Atmosphere**
- **Ethylene**
- **Time**

Ethylene effects on melons

- Improve color
- Improve aroma
- Increase pulp softening
- No effect on sweetness



Honeydew melon harvest and packing





Field packed melons waiting to be cooled

Night harvest of cantaloupes



Forced air cooled Gravity flow racks



Harvest into field bins



Place on conveyor for sizing by Photoelectric eye

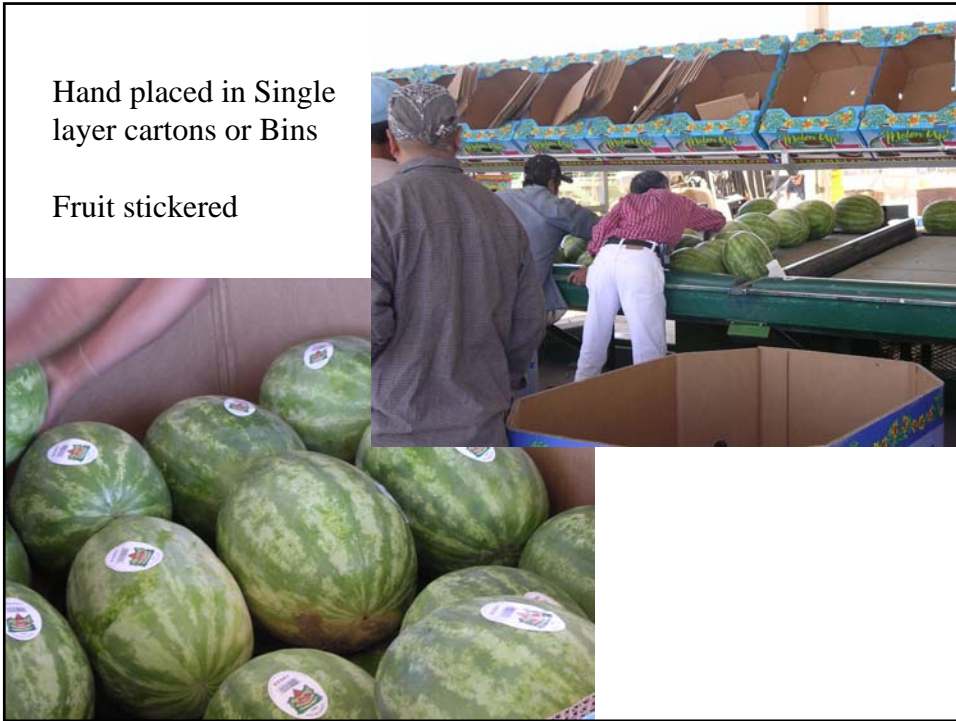


Computer controlled sizer

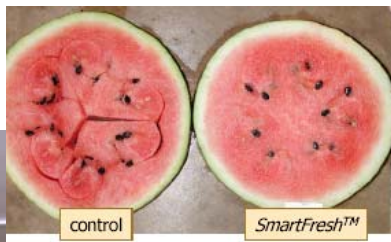


Hand placed in Single layer cartons or Bins

Fruit stickered



Careful with propane forklifts
Watermelon sensitive to ethylene

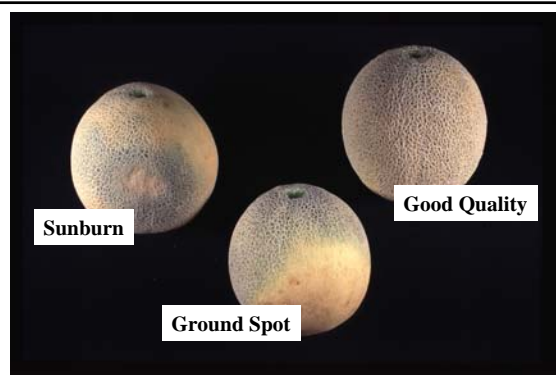
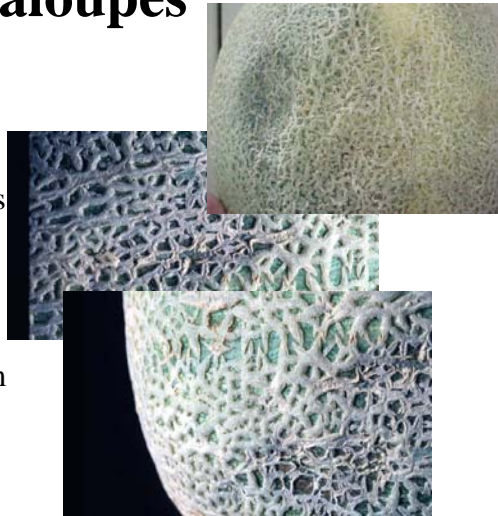


Room cooling to about 15C



Common Postharvest Defects: Cantaloupes

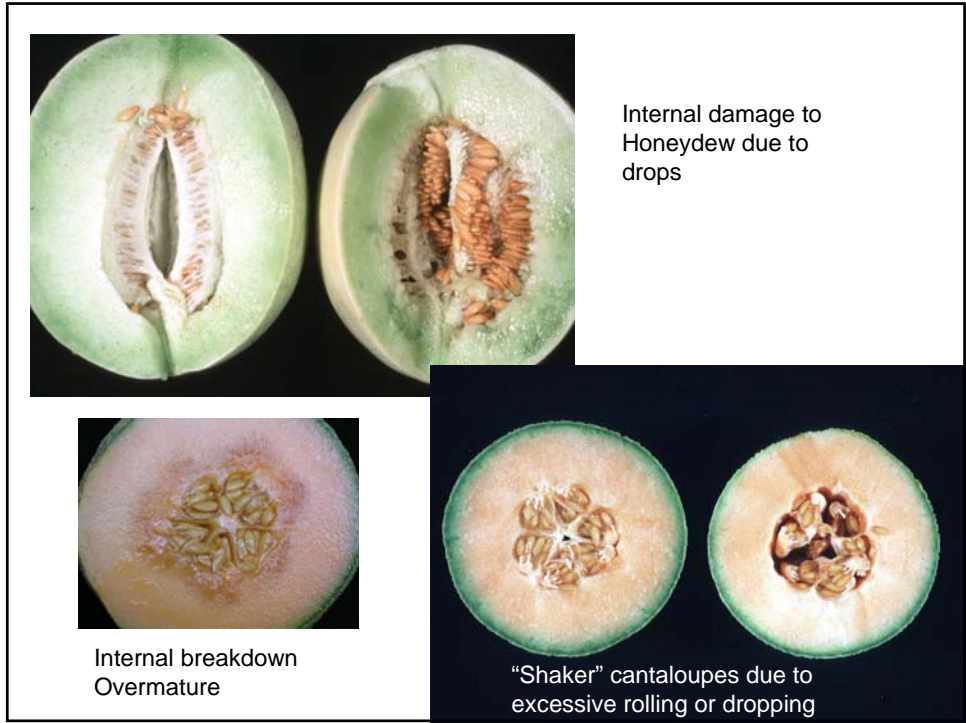
- Harvested immature
- Overripe
- Sunken areas on surface
- scuffing, water loss
- Discolored surface areas
- sunburn, scuffing
- Soft ground spot
- Decay, especially on stem end
- “Shaker” melons



Melon Defects and Internal Quality

Parameter	Good Quality	Ground Spot	Sunburn
Firmness (N)* (LSD=0.3)	10.7	9.3	6.3
Soluble Solids (%) (0.6)	11.5	10.5	7.9
Color (chroma) (0.7)	32.4	32.2	31.7

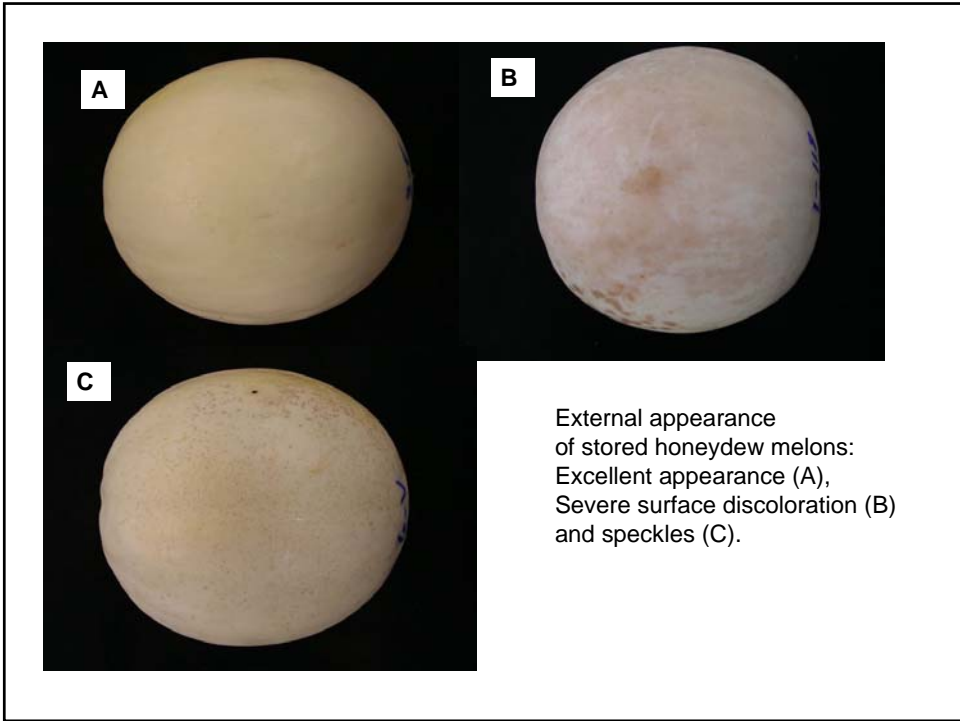
* 5 mm diameter probe

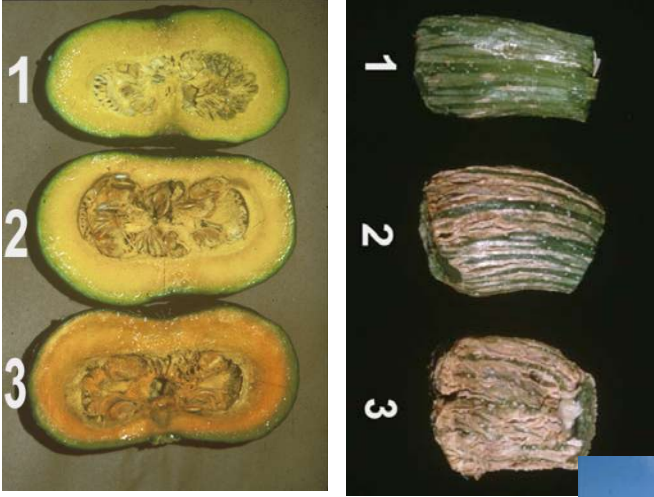


Common Postharvest Defects: Honeydews

- Harvested immature
- Overripe
- Chilling injury
- Brown blotch
- Decay
- Internal breakdown
 - dropping
 - impact injuries








Kabocha squash

Maturity at harvest is key
Careful Handling is key
Squash are chilling sensitive











Pulp



Hue	78.03	74.80	68.39
Dry Weight (%)	11.2	13.9	14.9
Total Sugar (sucrose)			
(mg/g DW)	465.84	565.34	631.47
(mg/g FW)	52.29	77.83	94.82

October 2004



Stored in air 7 months			10°C (50°F) 88% decay
			12.5°C (55°F) 25% decay
			15°C (59°F) 8% decay
			20°C (68°F) 8% decay