


## Postharvest Quality of Pitahaya

A. Review Aspects of Quality & Composition  
 B. 2012 Research on Maturity & Quality  
 C. Review of Storage Conditions





**Pitahaya FIELD DAY**  
POSTHARVEST TECHNOLOGY

Seminar - Friday August 23, 2013  
 San Marcos Civic Center  
 3 Civic Center Dr., San Marcos, CA 92069

Fruit Day Festival - Saturday August 24, 2013  
 U.C. South Coast Research and Extension Center  
 7501 Irvine Boulevard  
 Irvine, CA 92618

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## Pitahaya Fruit Composition (near full ripe at harvest)




- Water (85-88%)
- Carbohydrates (10-15%)
  - Sugars (mostly glucose, fructose)
  - Soluble solids (10-15%)
  - Dietary fiber (0.6-0.8%)
  - Mucilage, not well studied
- Minerals: calcium, potassium
- Vitamins: small amounts of Vitamin C
- Pigments in red flesh: Betalains
- Polyphenols

• Sugars to not increase after harvest  
 • Harvest maturity is key for good eating quality

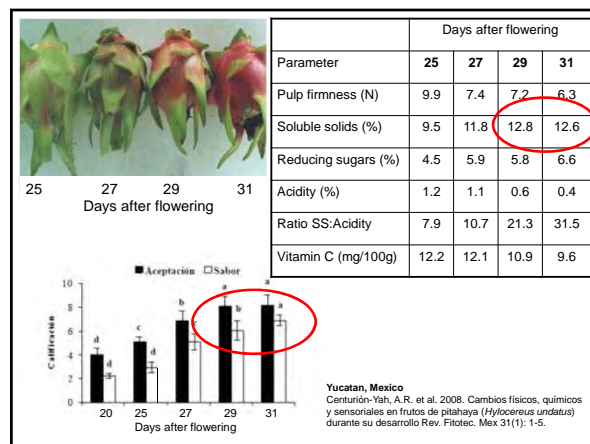
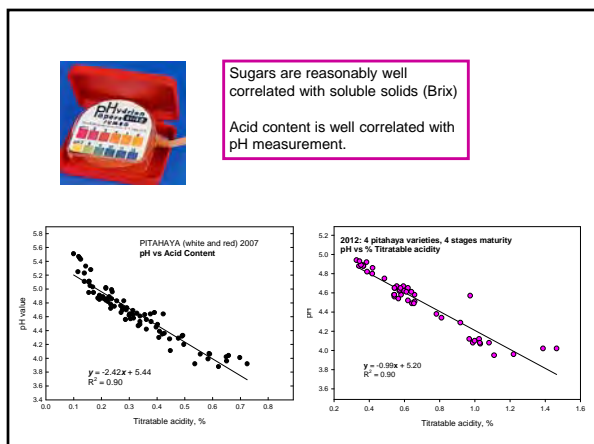
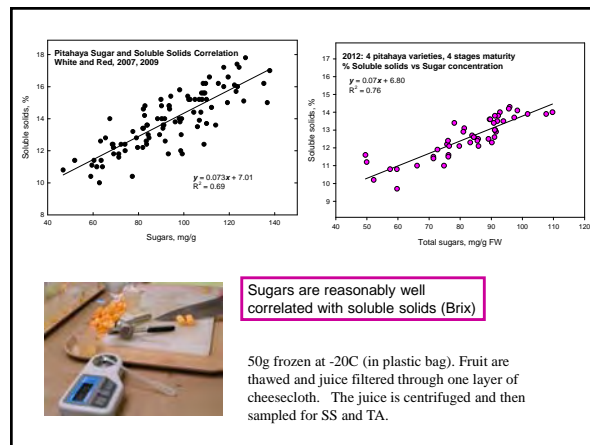
} High Antioxidant & Antiproliferative Activities in Red Flesh fruits

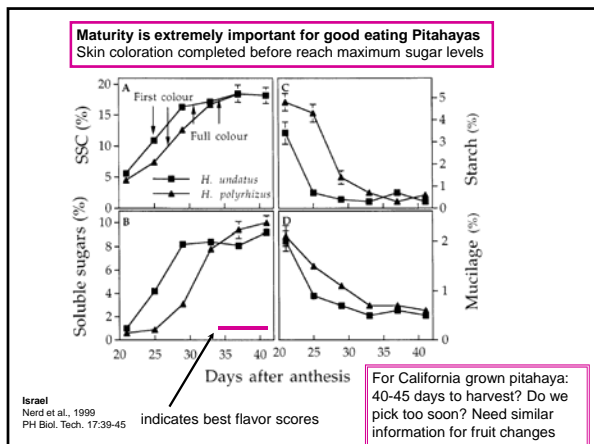
### Pitahaya ripe fruit quality and composition

Cultivar	Fruit wt. g	Skin/pulp color	% pulp	Soluble solids, %	Sugars mg/100g	pH	Titratable acidity, %	Total Vitamin C mg/100g
1 Cebra	401	Red/Red	59	11.2	86.2	3.97	0.57	8.6
2 Rosa	270	Red/Red	48	13.5	90.1	4.23	0.53	8.7
3 Orejona	333	Red/Red	53	13.2	91.0	4.20	0.51	8.5
6 San Ignacio	456	Red/Red	72	14.2	95.4	4.66	0.35	5.8
9 Valdivia Roja	314	Red/Red	63	14.3	87.6	5.31	0.14	6.8
10 Bien Hoa Red	612	Greenish red/fuchsia	66	14.0	67.4	4.64	0.30	6.6
12 Delight	160	Red/pinkish white	57	16.2	115.6	4.97	0.23	10.4
14 Haley's Comet	243	Red/Fuchsia	57	16.9	113.7	4.64	0.32	9.4
15 Physical Graffiti	198	Red/pink	54	16.1	136.6	4.67	0.30	9.0
<b>AVERAGE</b>	<b>332</b>		<b>59</b>	<b>14.4</b>	<b>98.2</b>	<b>4.59</b>	<b>0.36</b>	<b>8.2</b>

Red flesh: cv 1, 2, 3, 6    Purple: cv 9, 10, 14    Pink: cv 12, 15    Cantwell and Lobo 2007 data

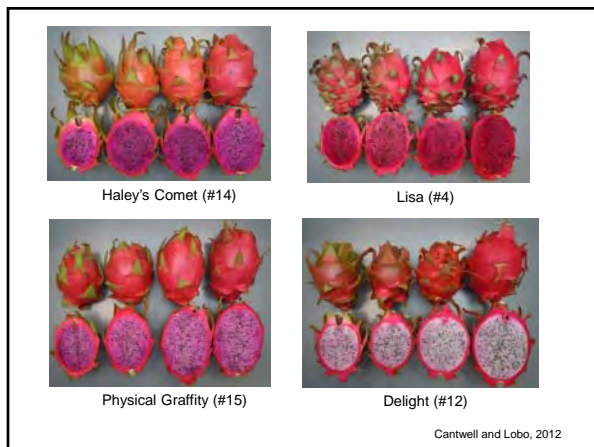




## Pitahaya Maturity 2012

- 1 Clearly immature**, never would be harvested commercially; serves as reference point
- 2 Early commercial harvest** (not full color, recognizable as early maturity)
- 3 Typical commercial maturity** (full or near full color, likely the best harvest stage)
- 4 Overmature** for commercial handling (bracts not as green, likely fruit is softer)

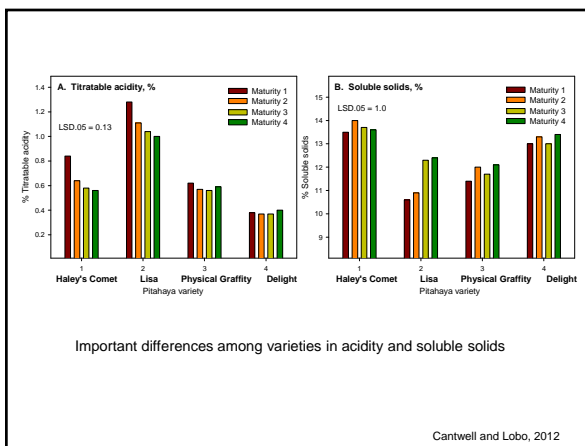
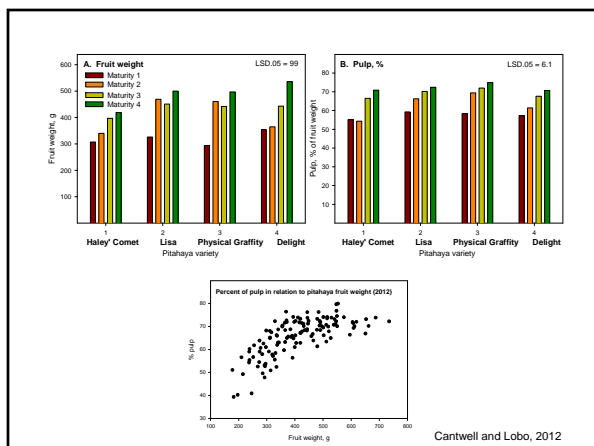
Cantwell and Lobo, 2012

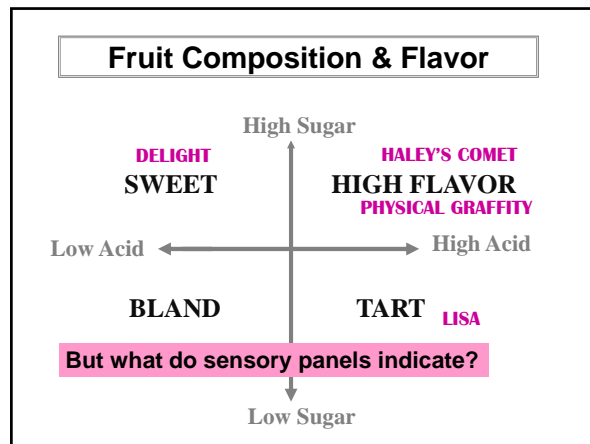
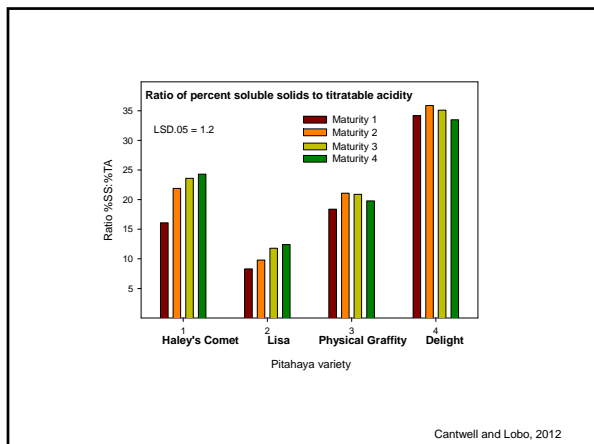


## 2012 Pitahaya Research: Maturity at Harvest

- 4 Pitahaya varieties at 4 stages of maturity**
- Fruit external characteristics**
  - Weight or size
  - Color of skin and bracts
  - Firmness
- Internal characteristics**
  - % pulp
  - Pulp texture
  - Pulp color
- Composition**
  - Soluble solids and individual sugars
  - Titrateable acidity and individual acids
  - Betacyanins
  - Antioxidant assay

Cantwell and Lobo, 2012





### Relative Sweetness of Sugars

- 15% solutions
- Sucrose = 100
- Fructose = 150-160
- Glucose = 70-80

Pitahaya variety	Total sugars mg/g FW	Fructose mg/g FW	%total	Glucose mg/g FW	% total
Haley's Comet	91.9	38.6	42	53.3	58
Lisa	70.7	29.4	42	41.3	58
Physical Graffity	75.3	26.3	35	49.0	65
Delight	92.2	31.3	34	61.0	66

Pancoast & Junk. 1980. Handbook of sugars. AVI Cantwell and Lobo, 2012

### Pitahaya Color

Cebra      Delight      Haley's Comet

Pitahaya variety	Internal Color Values	
	Chroma (Vividness)	Hue (Color)
Cebra	41.2	5.4
Rosa	46.5	7.4
Orejona	42.4	8.8
Lisa	41.4	10.3
Delight	12.3	-11.7
Haley's Comet	34.4	-18.3

Interactive color wheel  
http://www.fccid.org/jimmarip/style/color/wheel.html

### Pitahaya Internal Color (2012)

Fruit	Variety	L*	a*	b*	Chroma	Hue	Betacyanin*
1	Lisa	25.9	31.9	-0.3	31.9	-0.6	26.6
2	Haley's Comet	33.4	34.3	-11.3	36.1	-18.3	3.7
3	Physical Graffity	44.4	31.8	-7.7	32.7	-13.6	2.4
4	Delight	57.4	8.8	-1.4	8.9	-8.9	0.4

Cantwell and Lobo, 2012 \* mg/100g FW

### Betalains

- Red-violet pigments
- Water soluble
- Spectrophotometry; HPLC
- Natural food colorants
- Antioxidant properties

60 mg/100g juice  
Higher content than *Opuntia* fruit  
Stable over wide pH range  
Stable during fruit storage

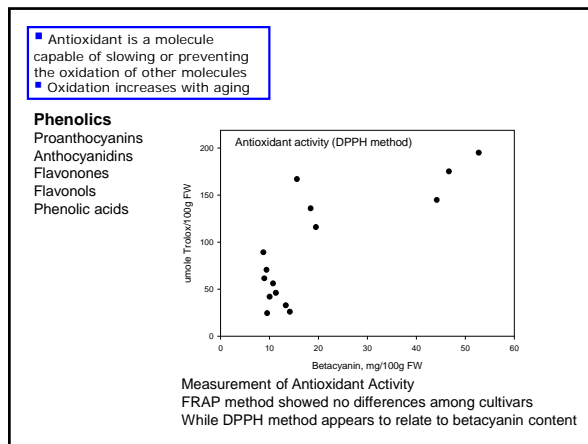
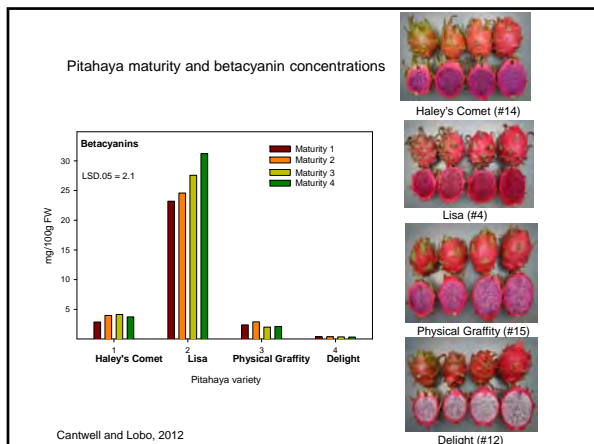
From Stintzing et al., 2003

R = H - Betanin  
R = CO-CH<sub>2</sub>-COOH - Phyllocactin  
R = CO-CH<sub>2</sub>-CH<sub>2</sub>-COOH - Hylococain

Betacyanins

1 = Cebra  
2 = Rosa  
3 = Orejona  
4 = Lisa  
5 = San Espinas  
6 = San Ignacio  
7 = Malvina Rosa  
8 = San-Hoa-Riad  
9 = Delight  
10 = American Beauty  
11 = Haley's Comet  
12 = Physical Graffity  
13 = Amalinda  
14 = Delight  
15 = Haley's Comet  
16 = Physical Graffity  
17 = Amalinda  
18 = Delight  
19 = Amalinda

\*1 Structures of the principle betacyanin in fruits from *Opuntia*. The C15-epimers isobetainin, isophyllocactin and hydrococcin are not shown.



### Causes of Quality & Postharvest Losses

#### Fruits

- Banana** ♦ Mechanical damage
- Apple** ♦ Maturity, immature, overmature
- Avocado** ♦ Poor ripening, conditioning
- Melons** ♦ Softening, texture loss
- Citrus** ♦ Changes in composition
- Mango** ♦ Water loss
- Tomato** ♦ Chilling injury
- Chiles** ♦ Microbial growth
- Berries** ♦ Microbial growth

### Pitahaya Postharvest Operations

- Twist, but better cut from the stem and place in crates or baskets for transport to pack area
- Transfer to a cool area (10-15°C)
  - to remove field heat and delay deterioration
- Sort for defects
  - remove dried floral tissues
  - Insects (mealybug, scale)
  - Wounds, cracks, etc.
  - Dehydration
- Select for color and size
  - small, medium, large; 300-380, 380-500, >500 g
- Rinse in potable or chlorinated water, dry;
  - possibly wax
  - wrap in paper
- Pack into labeled carton box
  - 6, 8, 10, 12 fruits per 4-5 kg box
  - 10 kg boxes

Dead floral parts  
Splits due to overmaturity  
Damaged stem end; cut fruit from stem

Bract yellowing at high temperature  
Compression damage  
Decay on bract, not penetrate pulp  
Internal bruising from dropping fruit

## Factors contributing to postharvest losses

- Respiration
- Water loss
- Damage
- Diseases
- Ethylene
- Continued growth
- Physiological disorders

Temperature  
TIME

## Pitahaya Storage (near full ripe at harvest)

**Postharvest Losses**  
 Dehydration, Shriveling  
 Mechanical Damage  
 Decay  
 Chilling Injury

- **Non-climacteric fruit; moderate respiration rate**
  - very low ethylene production
  - color is not stimulated by ethylene
- **10 to 12°C, 85-90% RH for shelf-life of 2-3 weeks; 14°C 2 weeks**
- **20-25°C (ambient) shelf-life of ~ 1 week**
- **Chilling sensitive**
  - Maturity, temperature, time all affect chilling damage
  - Chilling occurs at 8°C or lower (but 1 study indicated best temp is 6°C)
  - transfer from storage to warm conditions accentuates chill symptoms
  - Symptoms: bracts darken, lose flavor and firmness, pulp translucency
- **Postharvest decays**
  - Bacterial and fungal, associated with damage
- **Modified atmospheres**
  - 1-3% O<sub>2</sub> at 12°C; marketable to 30D, but decrease in sugars, Vit C, acids
  - 2 reports of MAP up to 30 days, main benefit from reducing water loss
- **Quarantine treatments required for imported fruit**
  - Pitahaya and related cactus fruits are host for various fruit flies
  - Heat treatments (hot water and hot air); Irradiation

Corales & Canche 2008; Hoa et al. 2006; Lau et al., 2009; LeBellec et al. 2006; Nerd et al. 1999; Paul, 2002; Punitha et al. 2009; Vargas et al. 2007.

### STORAGE

**Fruit Surface**

- Loss of Gloss
- Water loss

**Bracts**

- Discoloration
- Damage
- Dehydration

cv Rosa ~3% weight loss

cv Haley's Comet

### Pitahaya Storage Changes in Composition

Data average 6 varieties,

After 10 days 10°C:

- 9% decrease soluble solids
- 12% decrease sugars
- 36% decrease acidity
- No change Vitamin C

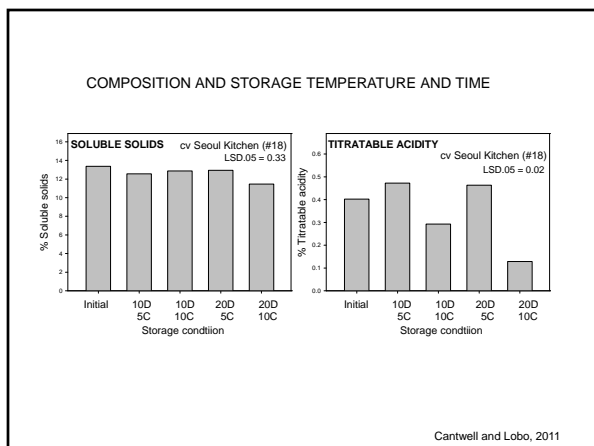
**A. % Soluble Solids**

**B. Total Sugars**

**C. Acidity**

**D. Vitamin C**

Cebra (#1), Rosa (#2), Orejona (#3), Lisa (#4), Delight (#12), Haley's Comet (#14)



## Pitahaya flavor quality and storage

- Can be insipid
- Harvested too soon?
- Stored too long?
- Stored at high temperature?
- Less flavorful variety?
- Importance of acids to overall flavor
- Sugars (usually) and acids (always) decrease during storage

What do all these fruits have in common?



Flavor determined by maturity at harvest  
Flavor declines with storage time

Thank you for your attention!

