

# Pitahaya (Dragon Fruit) Research & Production in California

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# Overview

- Background information
- Pitahaya production worldwide
- The need for pitahaya research
- Current research efforts at UC
- Field observations & results to date
- What next?

# The Pitahaya

- Also known as Strawberry Pear, Dragon Fruit in South East Asia, and Pitaya in Central America
- Native to tropical America, range from Southern Mexico to Northern South America
- Taken by the french to South East Asia at the turn of the 19<sup>th</sup> century

# Pitahaya Types

- Over 25 species of *Hylocereus* identified
- Differentiated by stem & fruit characteristics (fruit skin and flesh color)
- Uncertainty about proper ID
- Two commonly available in CA:
  - *Hylocereus undatus* (red skin, white flesh)
  - *Hylocereus* sp. (primarily red skin & red flesh)
  - Many *Hylocereus* hybrids (several skin and flesh colors combinations, from yellow to deep magenta or dark red)
- *Selenicereus megalanthus*
  - Yellow or Colombian - yellow, thorny skin and white, translucent flesh

# Why Pitahayas?

- Great potential as a new crop for growers in California
- Increasing demand for new, exotic fruits
- Current demand exceeds supply, current prices are high (retail @ \$10/pound)
- Relatively high antioxidant activity when compared to other subtropical fruits



# Pitahayas in California



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# Commercial Production

- US production is limited to small scale producers of *Hylocereus* sp. in California and Florida, few large plantings
- Mostly white fleshed varieties used for fresh consumption or for décor/garnish
- Red fleshed varieties becoming more popular for fresh consumption and for processing

# Commercial Production

- Nicaragua is main producer of *Hylocereus* sp. (red flesh) in Central America
  - 800-1000 Hectares planted under various production systems
- Fruit consumed fresh or processed for use in ice cream and refreshments
- Pitahaya pulp exported to US and as fresh fruit to Canada and Europe (APRONOT)





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# Commercial Production

- Colombia top producer of yellow pitahaya (*Selenicereus megalanthus*) in South America
- Ecuador also producing both *Hylocereus* sp. and *Selenicereus megalanthus*
- Vietnam main producer of *Hylocereus undatus* in South East Asia
- Israel also a significant producer/shipper to the European Union





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# Varieties??

- Twenty five species and up to 70 different clones available in Southern California
- No data or information available on the performance of various clones
- Lack of reliable, consistent information about varieties a major challenge to growth of industry
- 18 varieties under experimentation at SCREC

# Commercial Varieties?

- Five clones grown commercially in Nicaragua
  - Orejona, Rosa, Cebra, Lisa, San Ignacio
  - Many other clones available
  - All produce fruit without hand/cross pollination
- Several clones promoted as “superior” but no replicated research data available
- Huge challenge for commercial production



# Current Research Efforts

- Evaluate varieties for commercial production in California
  - Concentrate on self-fertile varieties with good yield, fruit & flavor characteristics
- Use molecular markers to narrow gene pool for breeding program
- Determine irrigation requirements
- Evaluate promising varieties in controlled environments

# Varieties Under Study

- Cebra (Nic)
- Rosa (Nic)
- Orejona (Nic)
- Lisa (Nic)
- Sin Espinas (Nic)
- San Ignacio (Nic)
- Mexiana (Mex)
- Colombiana (SD/Col)
- Valdivia Roja (Mex)
- Bien Hoa Red (SD)
- Bien Hoa White (SD)
- Delight (SD)
- American Beauty (FL)
- Haley's Comet (FL)
- Physical Graffiti (FL)
- Vietnamese Jaina (FL)
- Yellow Dragon (FL/Col)
- Seoul Kitchen (FL)

# Propagation

- Cuttings is most preferred method for commercial plantings
  - use one year old wood, at least 12 inches long
  - May fruit after one year
- Seed germinates readily, great potential for breeding program
  - Slow grower, may take up to 6 years to fruit
- Grafting is also possible, but benefits not quite clear yet



# Planting & Planting density

- Rooted cuttings are most common method, but direct planting of cuttings is possible
- 12 to 18 inch long cutting is ideal
- Plant spacing depends on production system
  - 6 by 10 feet spacing used in Nicaragua (600 pl/ac)
  - 4 by 6 observed in California and reported in Spain
- Spacing depends on trellis system and plant structure desired

# Pruning

- There is no best way to prune
- Pruning system will depend on trellis/support system, variety, location, goals and desired plant structure
- Three basic Strategies or goals for pruning:
  - Training – usually prune to encourage upright growth during first year
  - Sanitation – removal of dead or diseased stems
  - Thinning – to improve air circulation and exposure to sunlight



# Trellising

- Impacted by variety, location and desired plant structure
- Many different types used in producing areas
  - Anything that can support a plant can be used
  - Live tutors used in Central America by small scale producers but not an option for SD because of water cost
  - Concrete posts used in Southeast Asia
  - Combination of metal pipes and treated posts used in San Diego
- Wire support system used in trials

# Single post support system

- Up to about 5-6 feet, depending on height of operator
- Promotes an umbrella or mushroom like structure
- Planting managed more like an orchard



# T Support System



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# Ladder type support system

- Similar growth as T-type
- Used with multiple cuttings per planting



# Wire support system



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# Pollination

- Night blooming cactus, large flowers
- Some are self-pollinating and some require hand/cross pollination
- Pollinized by moths and bats in Central America
- Hand and cross pollination has improved fruit set in Israel (up to 100% set)
- For commercial production we should concentrate on self pollinating clones



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# Pest Problems

- No major pest problems observed yet
- Cactus scale a problem in the greenhouse but not in the field
- Rodents (gophers and squirrels) can be a significant problem'
- Ants & aphids a problem, damage young shoots, and flower buds
- Weeds

# Cactus Scale





# Gophers & Rodents





# Ants & Aphids



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# Weeds



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# Fruit Uses

- Used in refreshments in Central America
- Red flesh used as colorant in the processed food industry (Snapples, Sobe)
- Consumed fresh, as a desert item in the US, Canada, and Europe
  - Sliced in salads or cut in half and served chilled, with flesh eaten with spoon
- Used for decoration – Southeast Asia, US

# Results to Date

- Varieties in trial adapted well to growing conditions at SCREC
- Most selections set fruit WITHOUT hand pollination
  - Pollination done by bees & other insects
- Plants in trial produce well WITHOUT shade
- Fruit size & quality good, good marketable yields but results NOT FINAL yet



# Results to Date

<b>Variety</b>	<b>Color Skin/Flesh</b>	<b>Avg. Wt. (gms)</b>	<b>Brix Score</b>	<b>Days to Harvest</b>
1. Cebra	Red/Red	468	17.05	46
2. Rosa	Red/Red	384	17.01	45
3. Orejona	Red/Red	438	17.3	45
4. Lisa	Red/Red	465	17.02	44
5. Sin Espinas	Pink/Red	393	16.5	43
6. San Ignacio	Red/Red	552	15.6	48
7. Mexicana	Pink/White	495	14.04	40
9. Valdivia Roja	Red/Red	250	17.9	40
10. Bien Hoa Red	Greenish Red/Fuccia	360	18.9	41
11. Bien Hoa White	Pink/White	388	11.85	37
12. Delight	Red/Pinkish White	371	18.08	41
13. American Beauty	Greenish Red/Fuccia	380	18.51	43
14. Haley's Comet	Red/Fuccia	482	16.7	38
15. Physical Graffiti	Red/Pink	374	17.93	40
18. Seoul Kitchen	Red/White	518	12.36	41



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# Results for Pitahaya Field Day

- External Appearance
- Flavor
  - When you can see fruit color
  - When you can't see fruit color (under red light)

American Beauty  
261 = 469



Bien Hoa Red  
203 = 562



Delight  
283 = 512



Lisa "Smooth"  
728 = 871



Physical  
Graffiti  
863 = 706

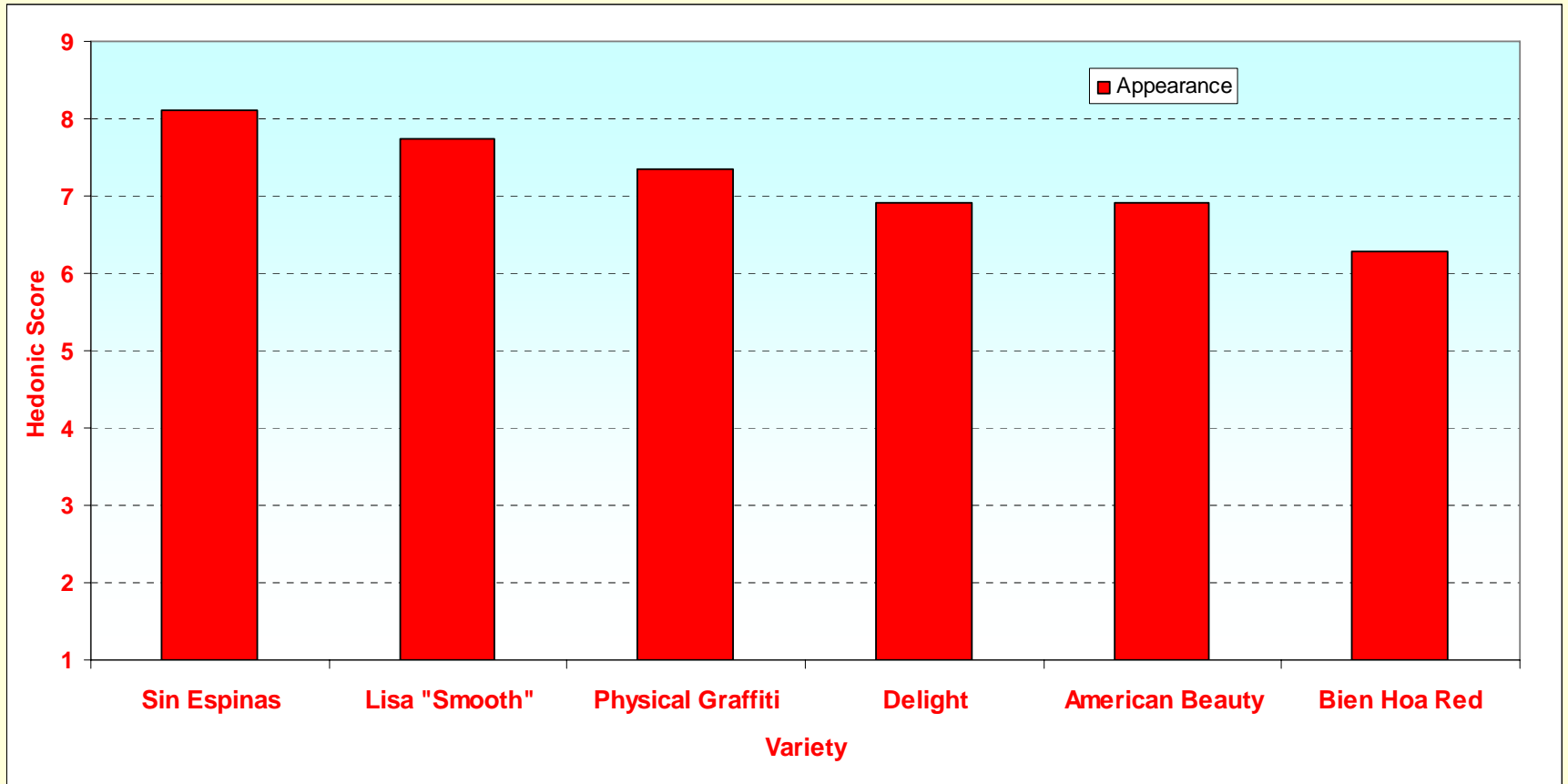


Sin Espinas  
268 = 102





# External Appearance



American Beauty  
261 = 469



Bien Hoa Red  
203 = 562



Delight  
283 = 512



Lisa "Smooth"  
728 = 871



Physical  
Graffiti  
863 = 706

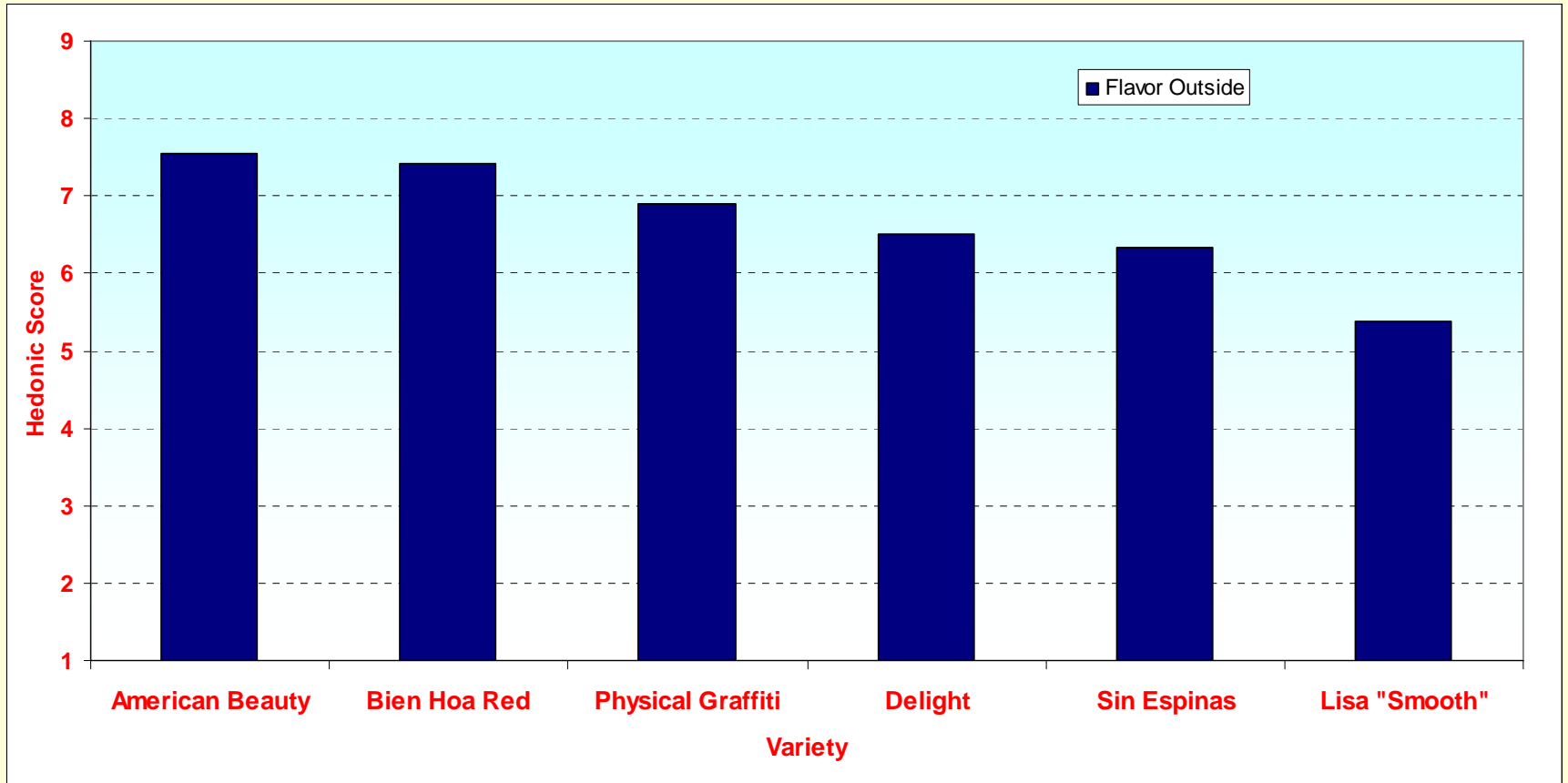


Sin Espinas  
268 = 102

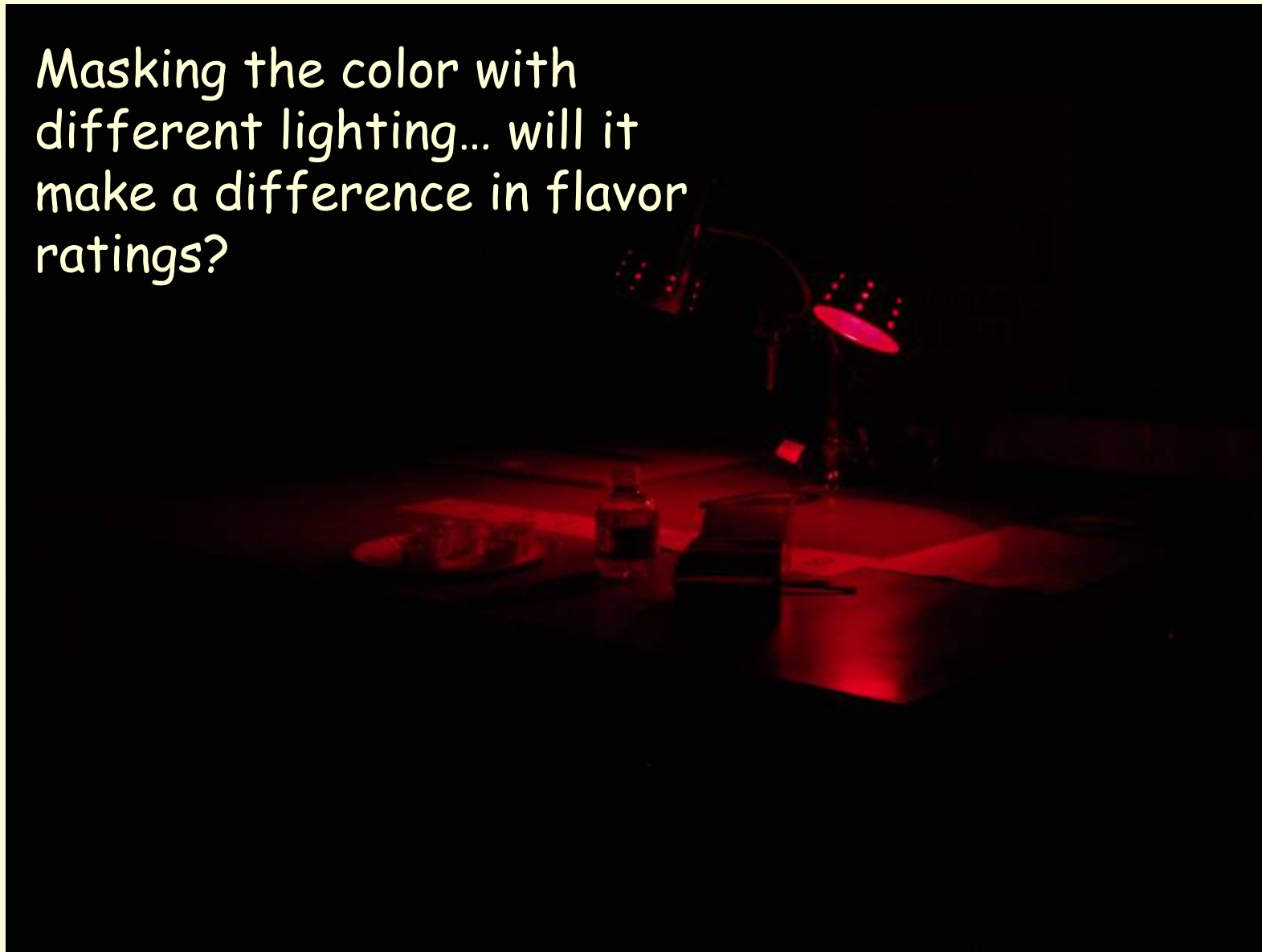


# Flavor

When you CAN see fruit color



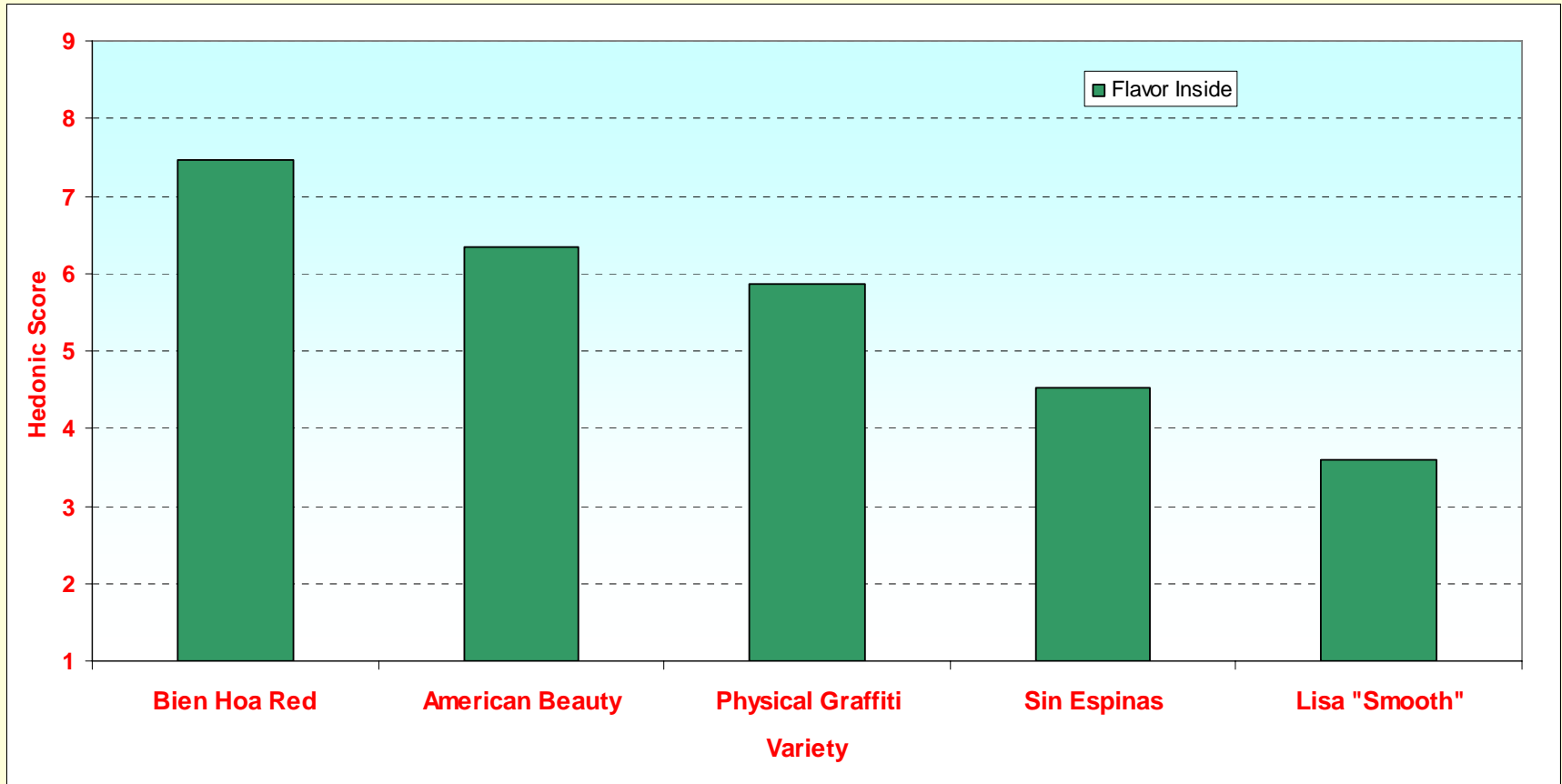
Masking the color with  
different lighting... will it  
make a difference in flavor  
ratings?





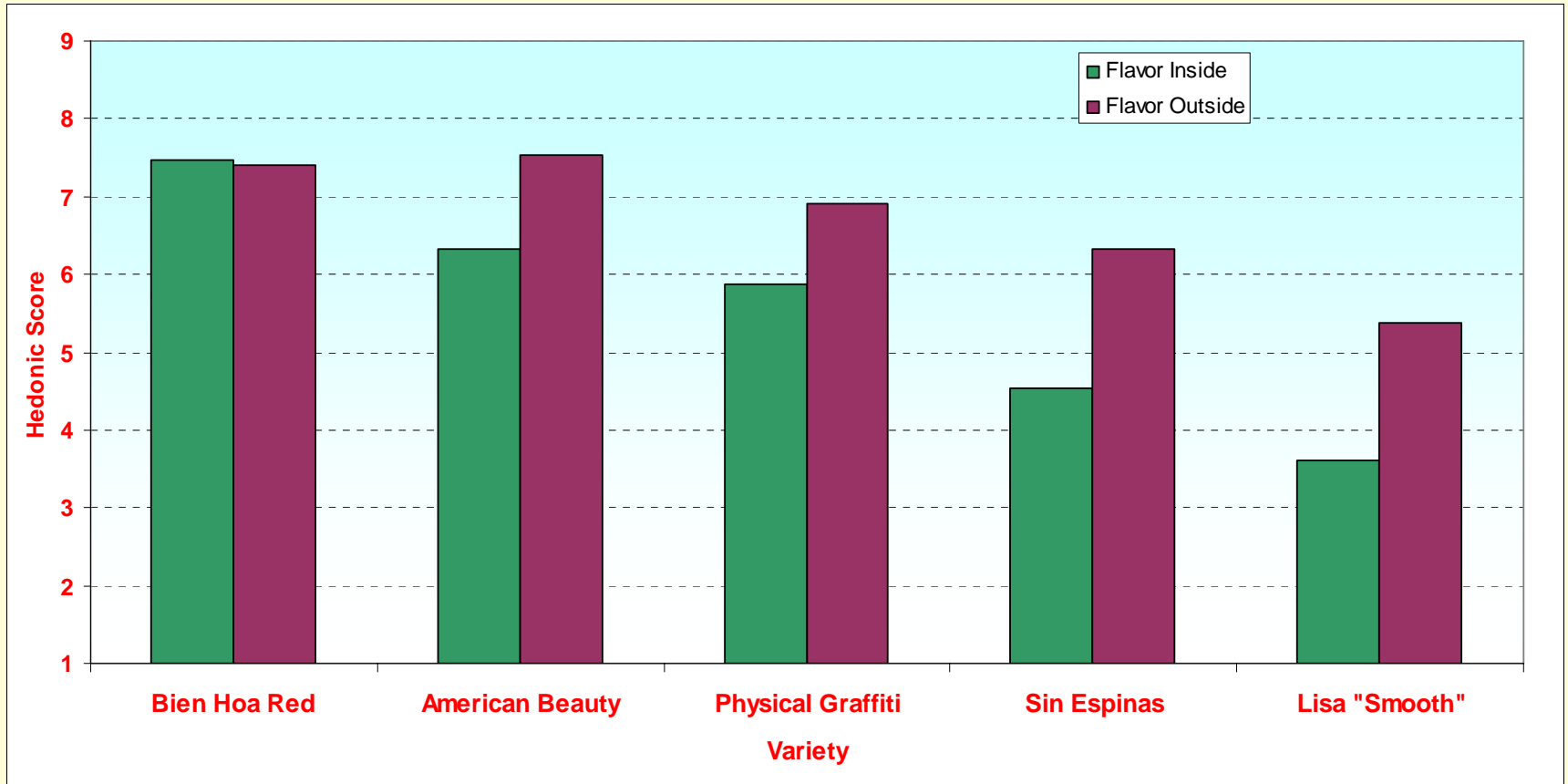
# Flavor

When you CAN'T see fruit color



# Flavor

Comparing the difference between 2 flavor tests



# Future Research Efforts

- Continue evaluation of varieties for commercial production in California
- Initiate breeding program based on field observation and results of molecular marker work
- Determine irrigation requirements
- Evaluate superior varieties in controlled environments

# Questions??

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