





## What do consumers really care about in fresh citrus?

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### What are consumers looking for in fresh fruit like citrus

- Color
- Freedom from defects or decay
- Size (depends on intended use)
- Anticipated flavor
- Good texture (not too tough, not too soft)
- Perceived health benefits



### External characteristics determine initial purchase

- Color (internal & external)
- Shape
- Size
- Decay
- Visible defects
- Peel luster
- Citrus type



### Color

- Orange color increases over the season for early-mid fruits due to cold night temperatures
- This causes chlorophyll (green pigment) to degrade and the carotenoids (orange pigments) to increase
- Early fruit may require degreening with ethylene gas, which promotes chlorophyll breakdown
- Sometimes a color like CR#2 can be added



### Use of waxes

- Add gloss or shine to fruit; shiny fruit sell better
- Reduce water loss that leads to shriveling of fruit (visible defect) and reduces fruit weight loss
- Reduces appearance of defects



### Citrus waxes

- Shellac coatings – shiniest, but can cause anaerobic off-flavors; impart some water loss control
- Carnauba wax – some shine, good water loss control, more permeable to oxygen
- Most packers are using coating mixtures of these 2 compounds to get benefits of both
- Mix fungicides imazalil or thiabendazole (TBZ) in waxes to control PH decay

## Decay



- Visual defect
- “Ick” factor
- Grey mold (*Botrytis cinerea*)
- Green mold (*Penicillium digitatum*)
- Blue mold (*Penicillium italicum*)
- Stem end rot (*Diplodia natalensis*)

## Internal and secondary characteristics

- Flavor
- Texture
- Juiciness
- Anticipated health benefits
- Number of seeds
- Ease of peeling



## Flavor



- Sweetness due to sugars (sucrose, glucose and fructose) often measured as soluble solids or Brix
- Acidity due to acids (citric and malic) often measured as titratable acidity (citric acid equivalents)
- Sweet/sour due to solids/acids ratio
- Aroma due to a delicate balance of 30-40 aroma volatiles including esters, aldehydes, ketones, sesquiterpenes and terpenes
- Bitterness due to limonin and nomilin
- Astringency due to flavonoids



## Health benefits

- Potassium
- Ascorbic acid
- Folate
- Flavonoids, (such as naringin, hesperidin, neohesperidin, citronin, narirutin)
- Polymethoxylated flavones (such as tangeritin, nobilitin, sinensetin and others)
- Carotenoids (such as  $\beta$ -cryptoxanthin,  $\alpha$ - and  $\beta$ -carotene, lutein, and zeaxanthin in general, and lycopene (blood oranges and red grapefruit))



## Storage disorders affecting appearance or eating quality

- Chilling injury (CI) resulting in long term storage below 12°C results in visible defects like pitting
- Preconditioning with hot water or air can help prevent CI
- Stem end (styler end) breakdown
- Granulation of juice vesicles
- Peel pitting due to humidity/warm temperature and possibly in conjunction with coatings



## Study on tangerines

Mall intercept interviews conducted by Ipsos-Reid

153 conducted January 22-29, 2008 (6 varieties)

154 conducted April 3-10, 2008 (4 varieties)

158 conducted October 22-30, 2008 (5 varieties)

Each set contained interviews in Chicago, Baltimore, and Tampa

Collected data on:

- Demographics of participants
- Sensory characteristics of tangerines
- Purchase usage and habits
- Perception of general attributes of citrus




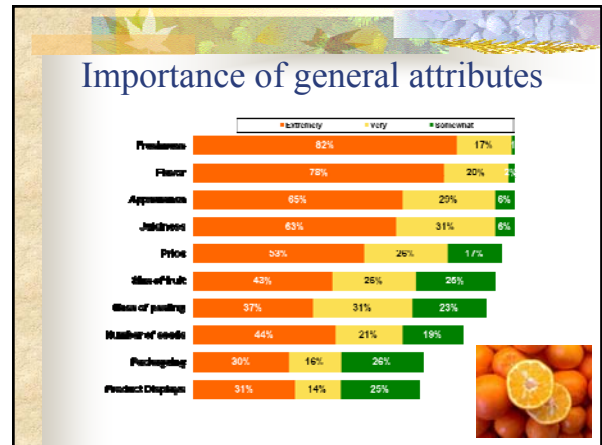
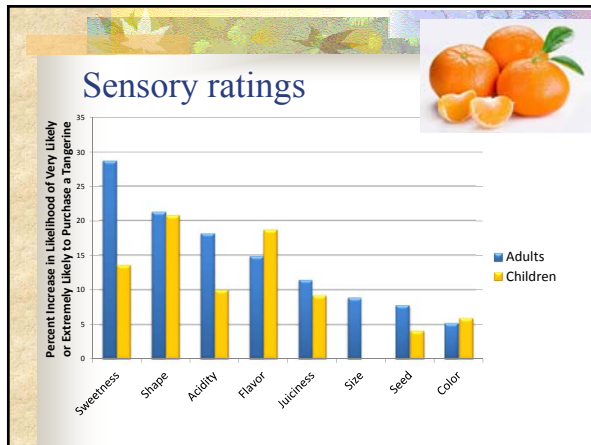
## Sensory ratings

- Analyzed which sensory characteristics statistically influence the rating of each tangerine
- Sweetness, Shape, Acidity, Overall Flavor and Juiciness were most influential**
- Size (for adults only), color, and amount of seeds were influential, but to a smaller degree
- Only overall appearance was not significantly related for both adults and children
- Size was not significantly related for children



## Flavor preferences for tangerine

- The most important sensory characteristics were: Sweetness, Shape, Acidity, Overall Flavor and Juiciness
  - Ease of peel was excluded due to collection issues
- The most important general attributes were freshness, overall flavor, overall appearance, and juiciness

## Conclusions

- Freshness, flavor, appearance and price appear to be important features consumers are looking for in tangerine and likely can extrapolate to other citrus types
- Size, ease of peeling and seediness were surprisingly less important

## Questions?

