Postharvest Handling: *Impacts on Fruit Quality*

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UF UNIVERSITY of FLORIDA IFAS

What Do Consumers Want?

- They choose which products to buy based on fresh appearance, packaging & price (extrinsic attributes)

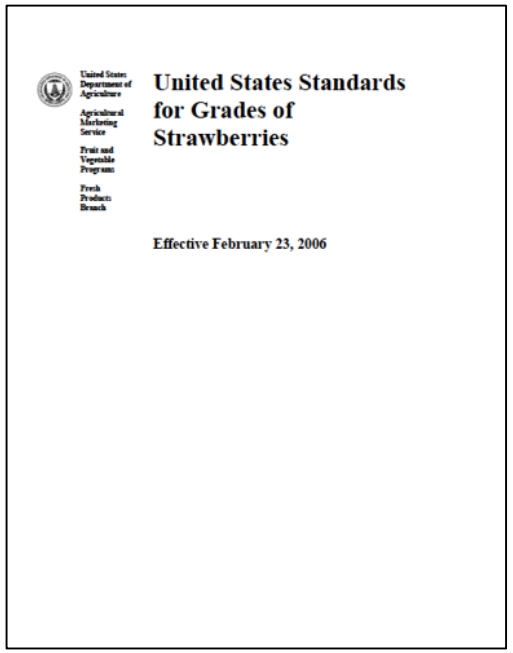
- The eating experience (aroma, taste & texture) is what determines whether they will continue to purchase the product (intrinsic or experience attributes)

What Do Consumers Want?

- Produce must appeal to consumers at the point of purchase on visual terms
  - Fresh appearance is paramount
- The consumer expects the product to have the sensory qualities associated with freshly picked fruits and vegetables
  - Aroma, taste and texture as well as visual appeal
  - Optimum ripeness stage
- The consumer also assumes that the product is safe, wholesome and nutritious

Postharvest Physiology

- Different fruits & vegetables have different potential postharvest lives
  - ➢ Strawberry: 10 to 14 days
- Maturity and quality at harvest determine postharvest life
- Optimizing quality after harvest starts with temperature control


United States Department of Agriculture
Agricultural Marketing Service
Fruit and Vegetable Programs
Fresh Products Branch

United States Standards for Grades of Strawberries

Effective February 23, 2006

U.S. No. 1 Strawberry Grade

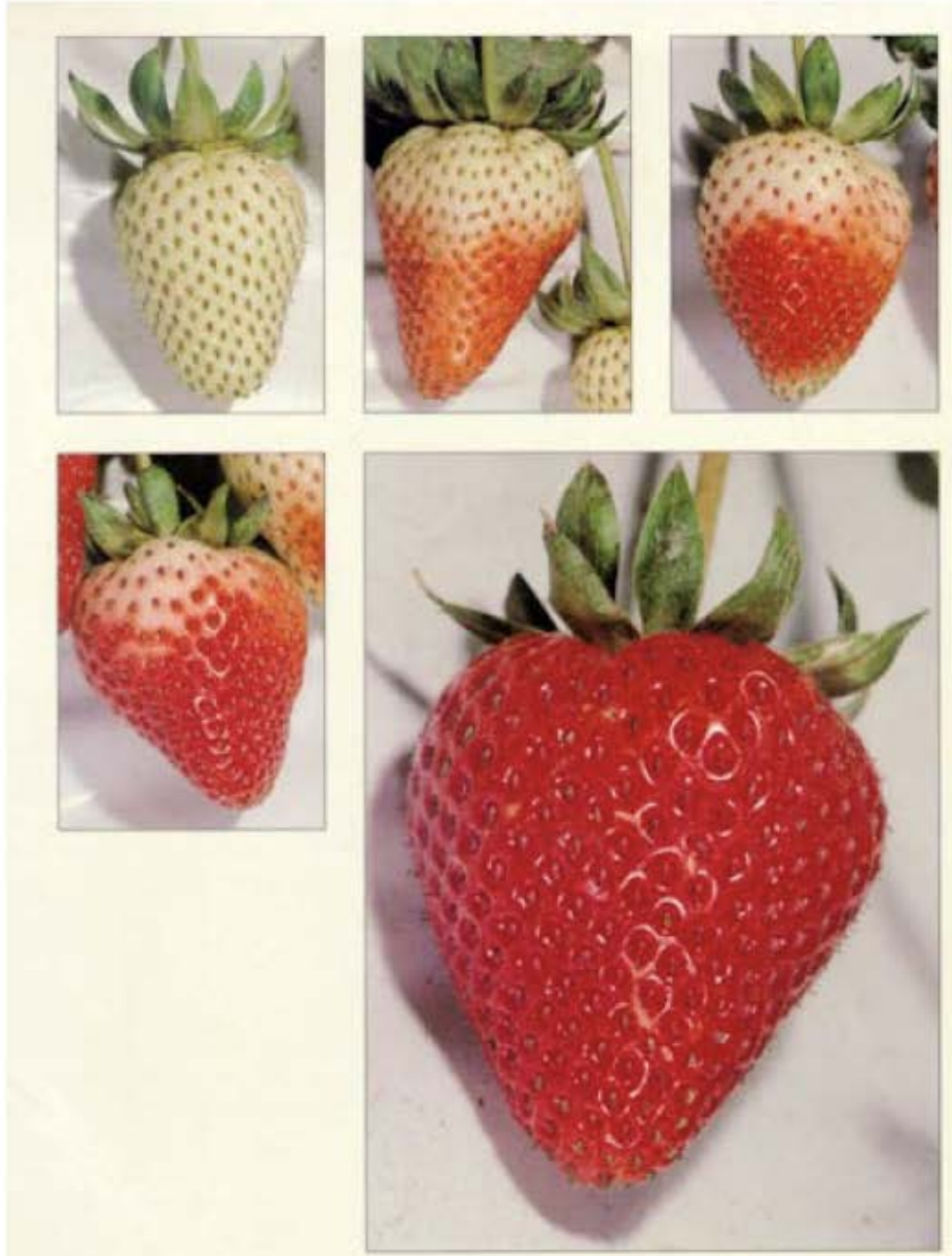
- Firm, not overripe or undeveloped, free from mold or decay, free from damage, at least ¾ red or pink, and not less than ¾-inch diameter
- Not more than 10% total defects (5% serious; 5% undersized; 2% decay)
- No individual basket with more than 20% total defects (10% serious; 4% decay; but one defective and one off-size fruit allowed)
  - Provided, the average for the entire lot is within the tolerances

Harvesting Stage of Strawberry Based on Color Development

Minimum color and colored surface area at harvest:

U.S. Standards: ½ to ¾ pink

California Code: 2/3 pink



Adel Kader & Beth Mitcham

Postharvest Physiology

- **Respiration** - Increases 2 to 3 times & postharvest life decreases by 1/2 to 2/3 with each 10°C (18°F) temperature change.

- The lower the temperature, the slower the respiration rate

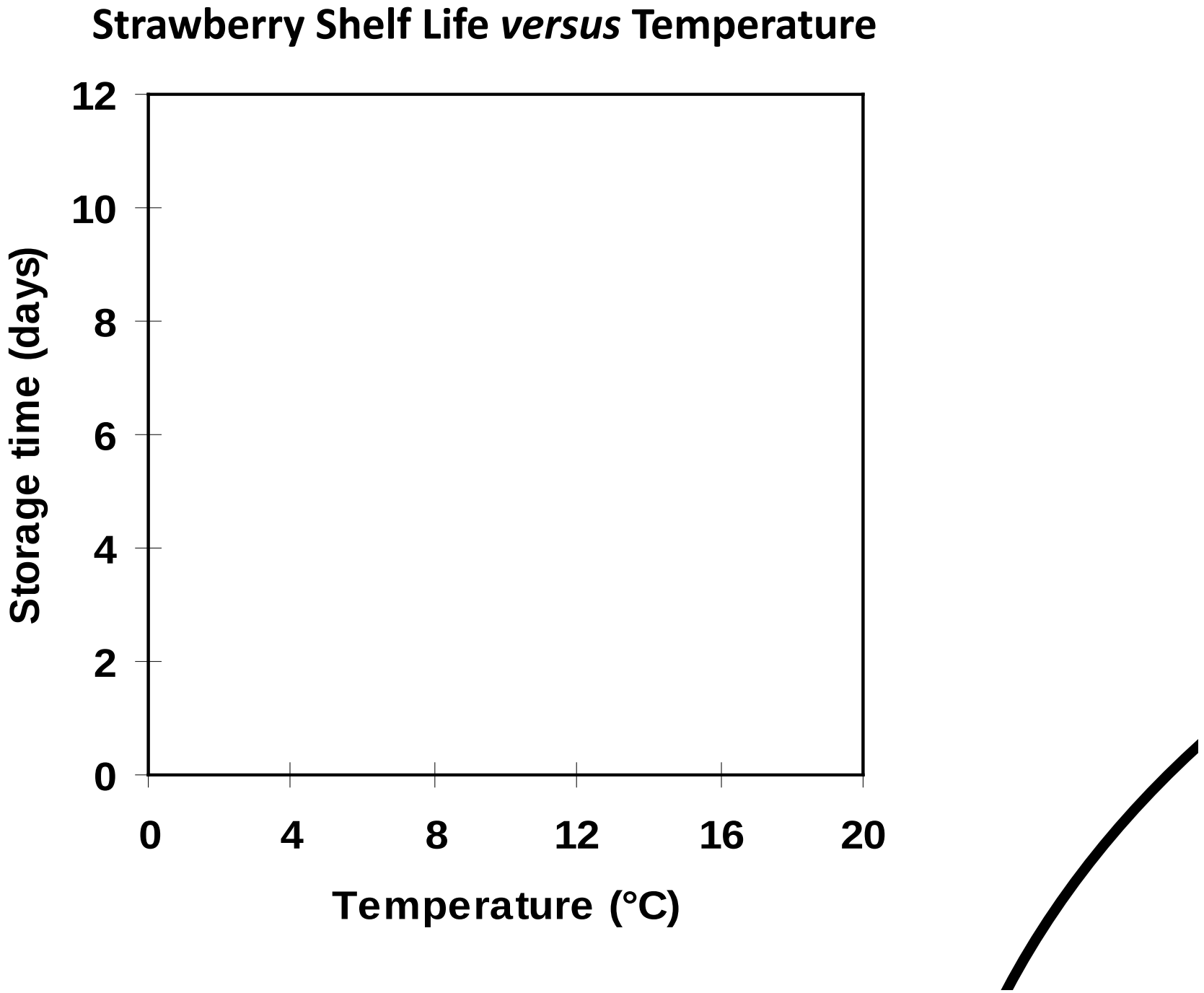
- The slower the respiration rate, the slower the rate of deterioration and the longer the shelf life

Cool it Fast
& Keep it Cool!

- Lowering the temperature as quickly after harvest as possible:
  - Slows respiration and metabolism; retains higher nutrient levels
  - Slows bruising symptom development
  - Slows water loss
  - Inhibits microbial growth (< 41°F)
    - Reduces decay
    - Minimizes food safety problems

Cooling Delays

- *Strawberries:*
  - A delay of only 2 hours at 86°F before cooling was sufficient to cause measurable losses in strawberry quality due to decay and more severe bruising symptoms (Mitchell et al., 1996)
  - A delay of 6 hours at 86°F caused measurable losses of firmness, sugars, and vitamin C (Nunes et al., 1995)


Strawberry Shelf Life *versus* Temperature
Storage time (days)
0
2
4
6
8
10
12
0
4
8
12
16
20
Temperature (°C)

CAUSES OF POSTHARVEST STRAWBERRY DETERIORATION

- Metabolic changes (respiration)
- Bruising and other mechanical injuries
  - Stimulate negative metabolic changes, shriveling, and decay
- Moisture loss (wilt, shrivel)
- Pathological breakdown (mold, decay)

Strawberry Postharvest Handling

- Hand harvested or “pick-your-own” operations.
- Grading and sorting occurs in the field to minimize handling steps.
- What does “cool quickly” mean?
  - 1 hour at a field temperature of 86°F may = 1 week at 32°F.
  - Forced air cooling is commonly used to quickly lower pulp temperatures.

Harvest Supervision

Accumulation at Cooling Facility

Forced-air Cooling

MA or CA for Strawberries

- 2 to 5% O_2 plus 15 to 20% CO_2 is useful, mainly to inhibit decay.

Would I Buy?

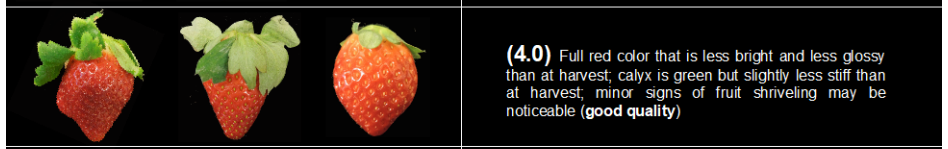
Definitely would

Borderline

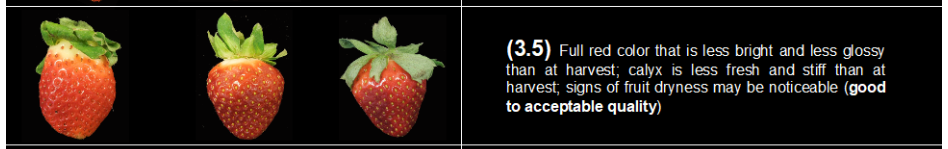
Definitely wouldn't

(5.0) 75 to 90% bright and glossy red color; calyx is stiff and green; no signs of bruising or shriveling on fruit; fruit appear to be very fresh (**excellent quality**)

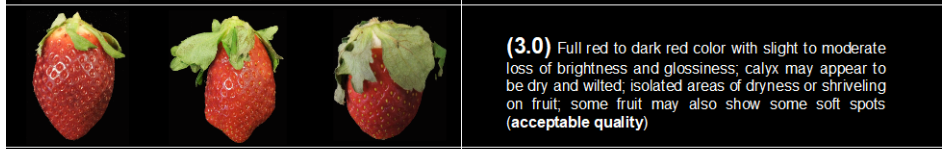
(4.5) 90 to 100% slightly less bright and glossy red color; calyx is green but slightly less stiff than at harvest; no signs of fruit shriveling (**very good quality**)



(4.0) Full red color that is less bright and less glossy than at harvest; calyx is green but slightly less stiff than at harvest; minor signs of fruit shriveling may be noticeable (**good quality**)



(3.5) Full red color that is less bright and less glossy than at harvest; calyx is less fresh and stiff than at harvest; signs of fruit dryness may be noticeable (**good to acceptable quality**)



(3.0) Full red to dark red color with slight to moderate loss of brightness and glossiness; calyx may appear to be dry and wilted; isolated areas of dryness or shriveling on fruit; some fruit may also show some soft spots (**acceptable quality**)

(2.5) Full red dark color with moderate loss of brightness and glossiness; calyx appears to be wilted and dry; fruit are moderately dry and shriveled; some fruit may also show soft spots (**acceptable to poor quality**)

(2.0) Very dark red color that is dull and not shiny; calyx appears to be dry and slightly yellowish or brownish-green; fruit appear to be overripe and dry; fruit are soft (**poor quality, non-salable under normal conditions**)

(1.5) Very dark and dull purplish-color; calyx is dry and wilted; fruit appear to be very soft, overripe and dry; some fruit may be leaky (**poor to very poor quality; not salable**)

(1.0) Very dark brownish or purplish-red color that is very dull and has no shine; calyx may appear to be very dry and yellowish or brownish-green; fruit appear to be extremely overripe, dry or leaky (**very poor quality**)

Would I Eat?

Definitely would

Borderline

Definitely wouldn't

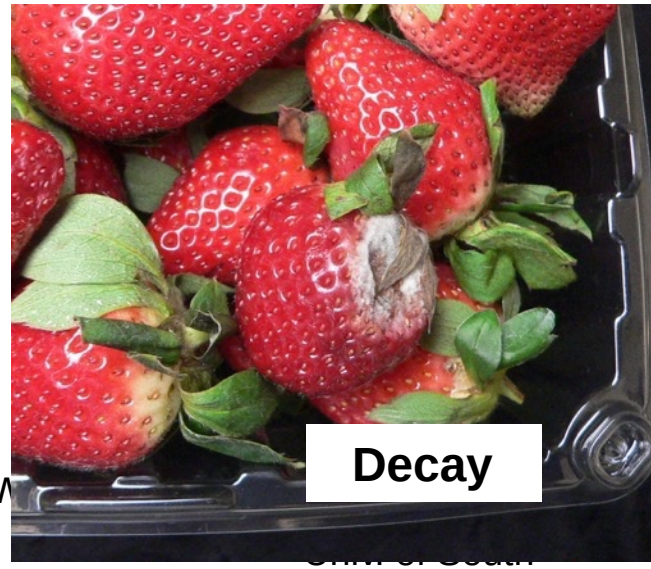
Rating scale with illustrations and definitions courtesy Dr. Cecilia Nunes, Univ. of South Florida

Would I Buy?

Definitely would

Definitely wouldn't

Definitely w

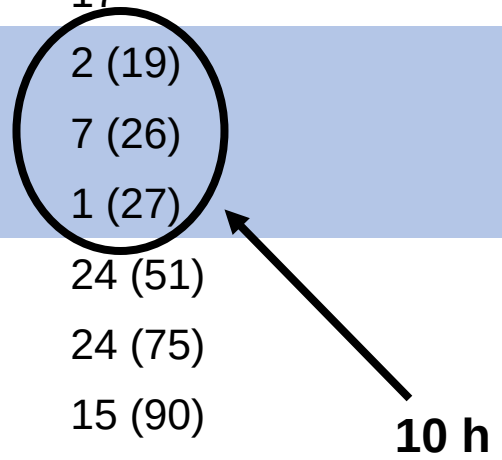


Florida

Maintain the Cold Chain

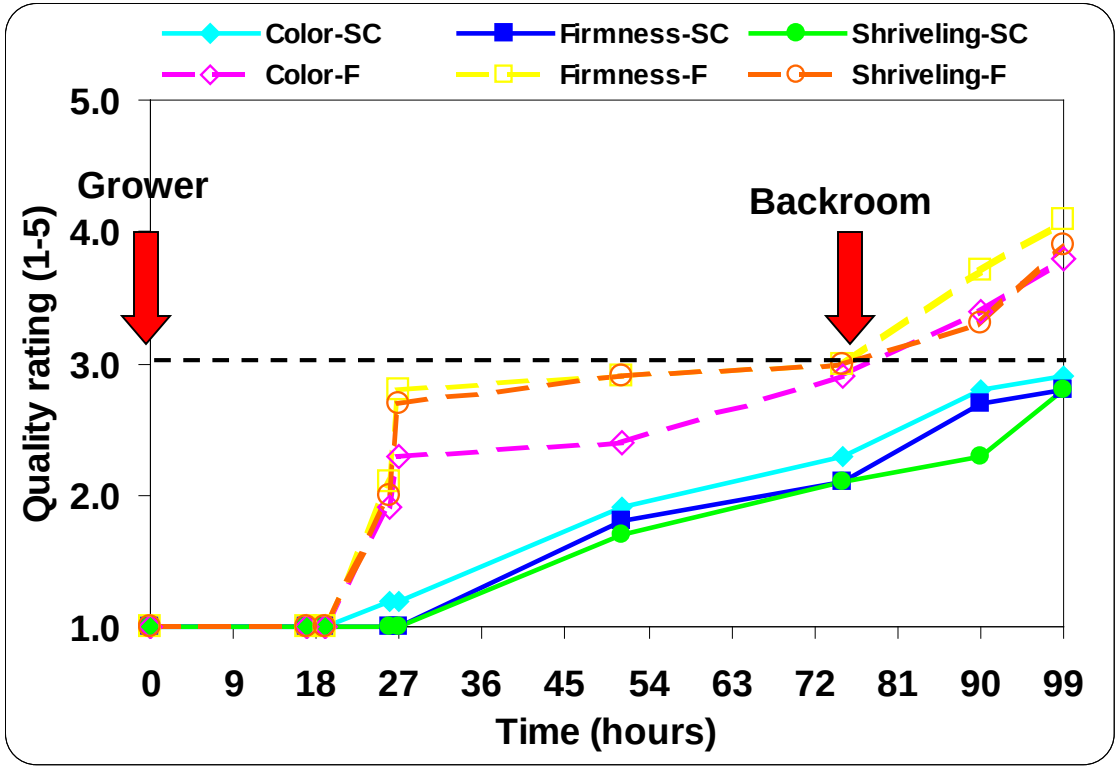
Handling times & temperatures during simulated handling from the grower to the retail display (chosen as representative of our measurements at each handling step and taken over a 5-year period)

Handling simulation	Time (hours)	Temperature (°F)	
		Semi-constant	Fluctuating
Harvest	0	75	75
Cooling facility and transport	17	37	37
Tarmac	2 (19)	37	50 (1 h) + 68 (1 h)
On airplane	7 (26)	37	68
Tarmac	1 (27)	37	73
Truck – Distribution Ctr. - Truck	24 (51)	37	37
Grocery store backroom	24 (75)	46	46
Retail display	15 (90)	68	68
Retail display	9 (99)	68	68
Total time	99 (4 days, 3 hours)		



Nunes et al., 2003

Limiting quality factors



Fluctuating temperature =

- Darker red color
- Softer fruit
- Shriveling
- Bruising symptoms

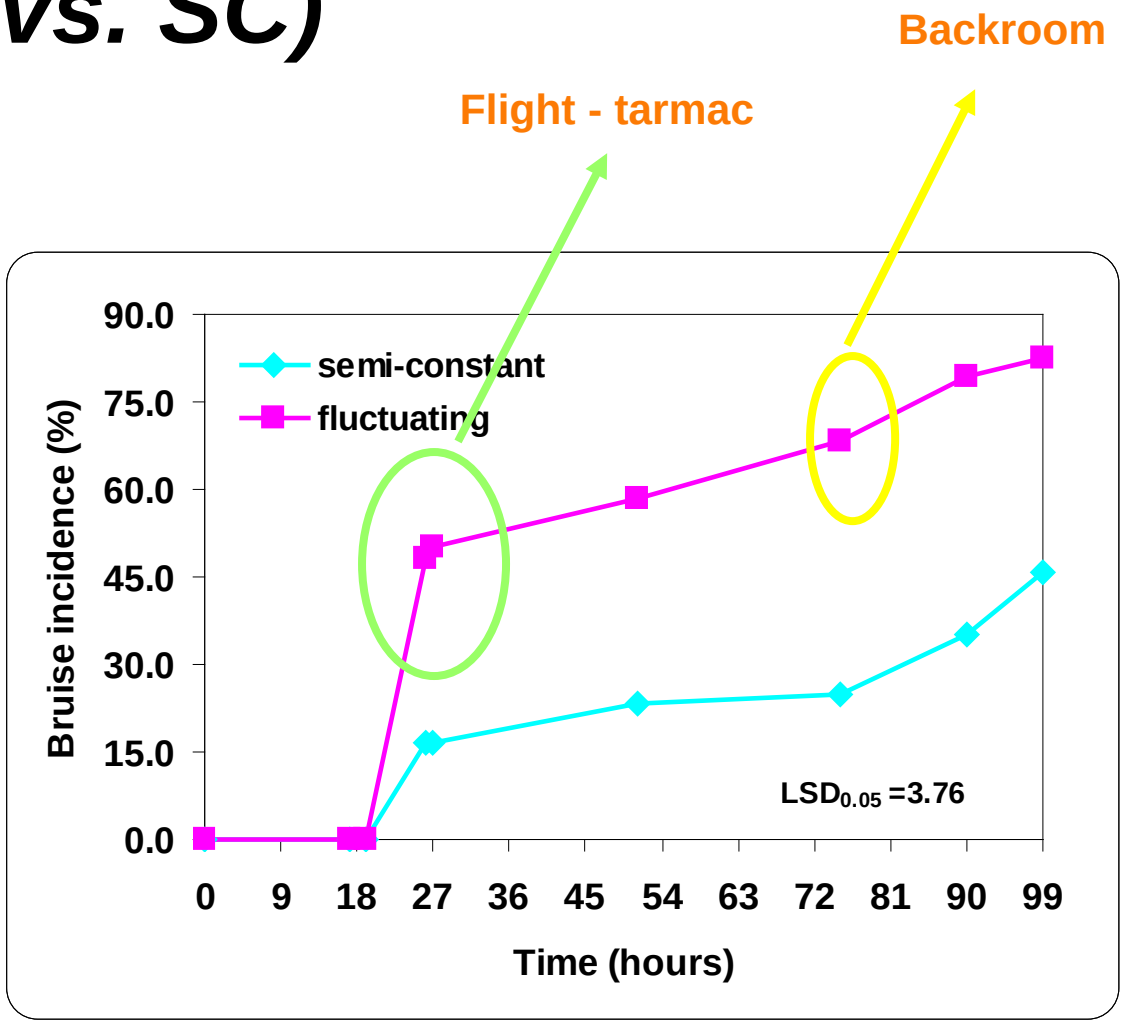
Fluctuating temperatures reduced the shelf life of the strawberries by more than a day

→ Never would have reached the consumer in this scenario

Unbruised fruit (F vs. SC)

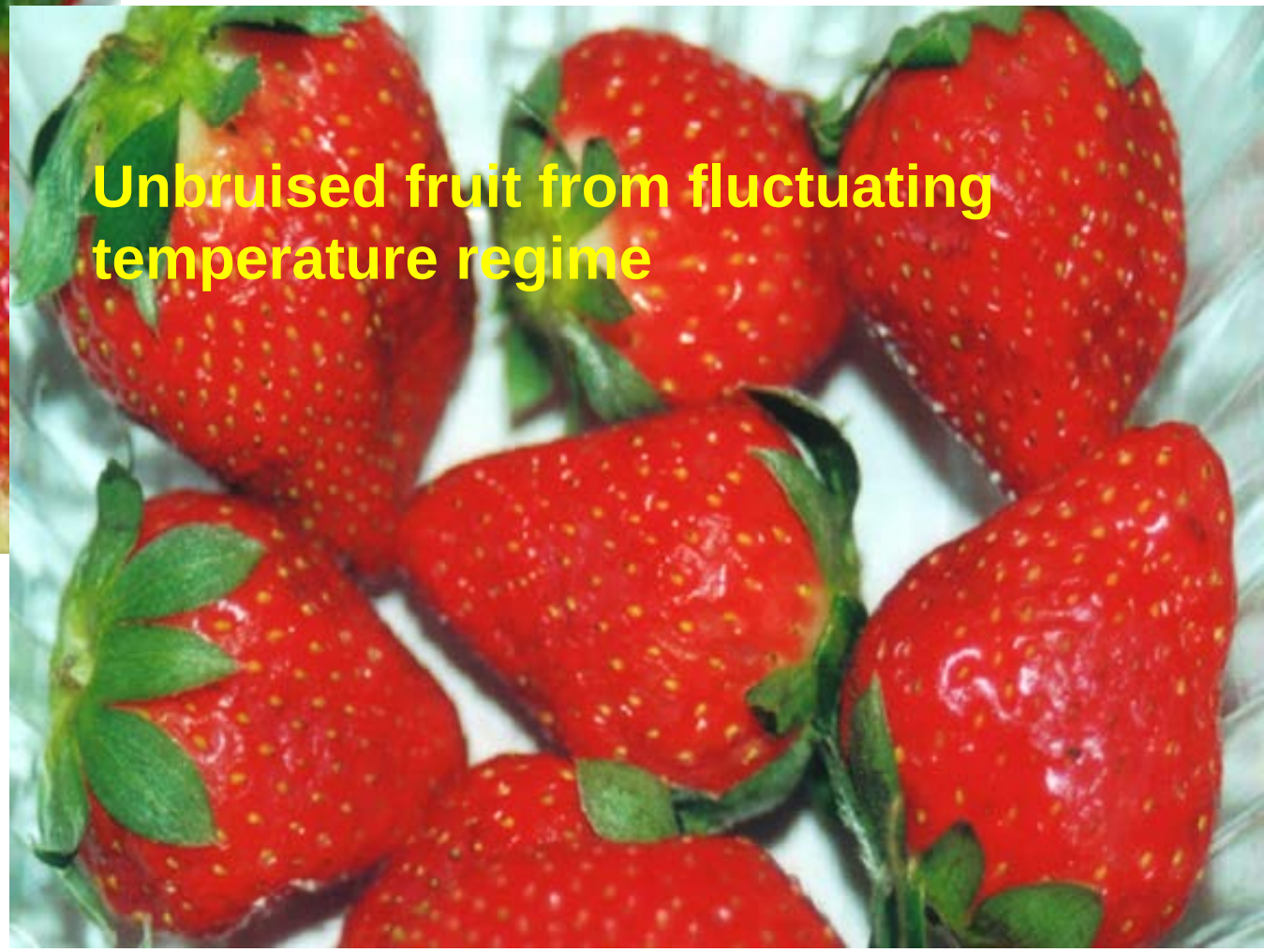
- After 19 h, bruise incidence was almost 3 times higher in F vs. SC (48.3% vs. 16.7%, respectively)

- After 75 h, F fruit were bruised and leaky



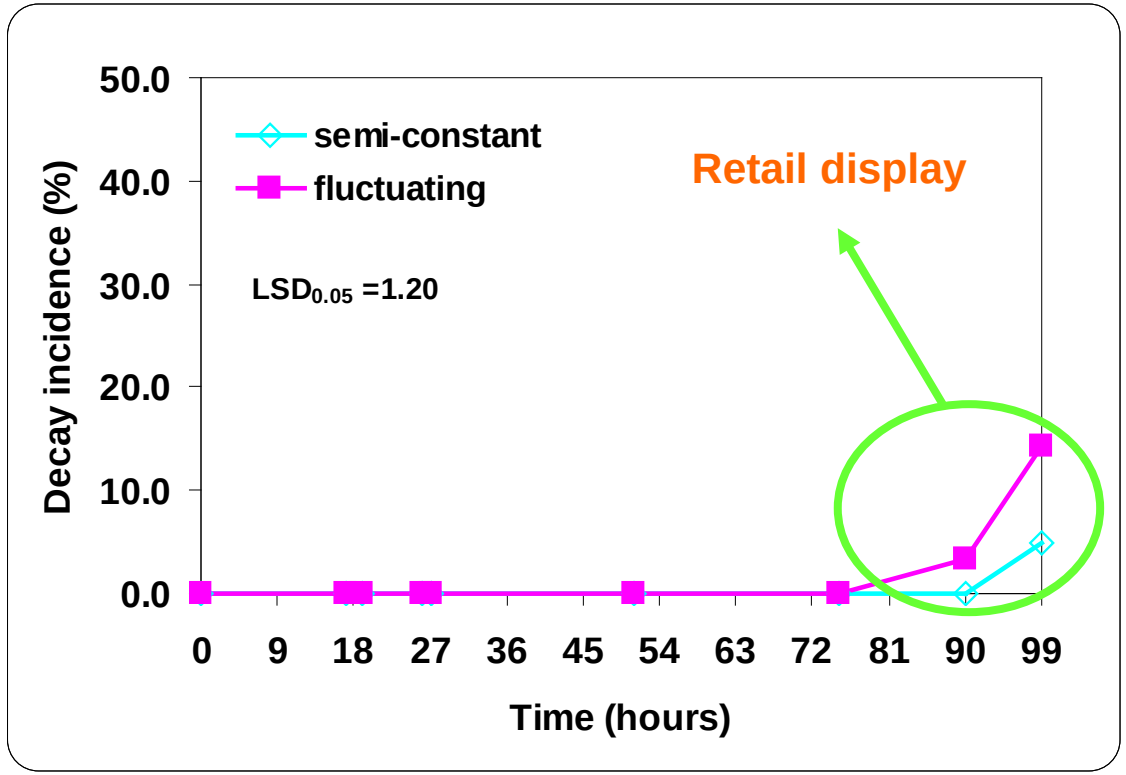
- *No* evidence of *decay* in fruits from either SC or F regimes

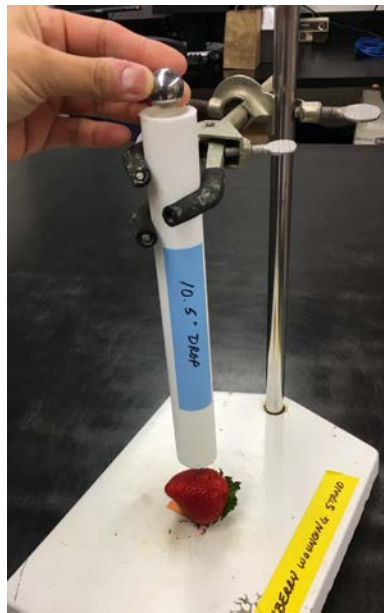

Unbruised fruit from semi-constant temperature regime


Unbruised fruit from fluctuating temperature regime

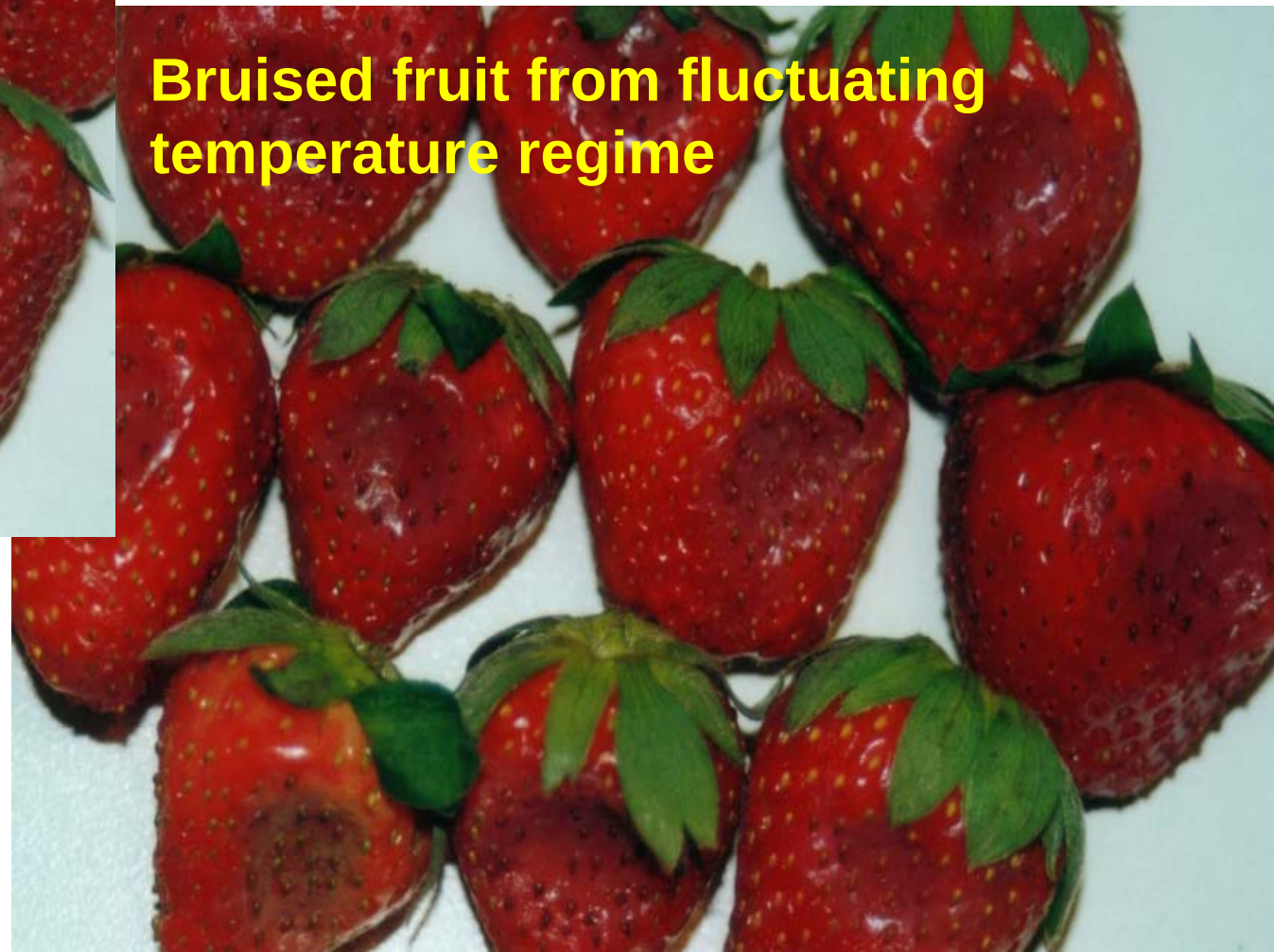
Bruised fruit (F vs. SC)

- *Decay* on the bruised area developed at the retail display level
- *14.0%* of fruits from F showed severe brown discoloration
- *5.0%* of fruits from SC showed slight brown discoloration

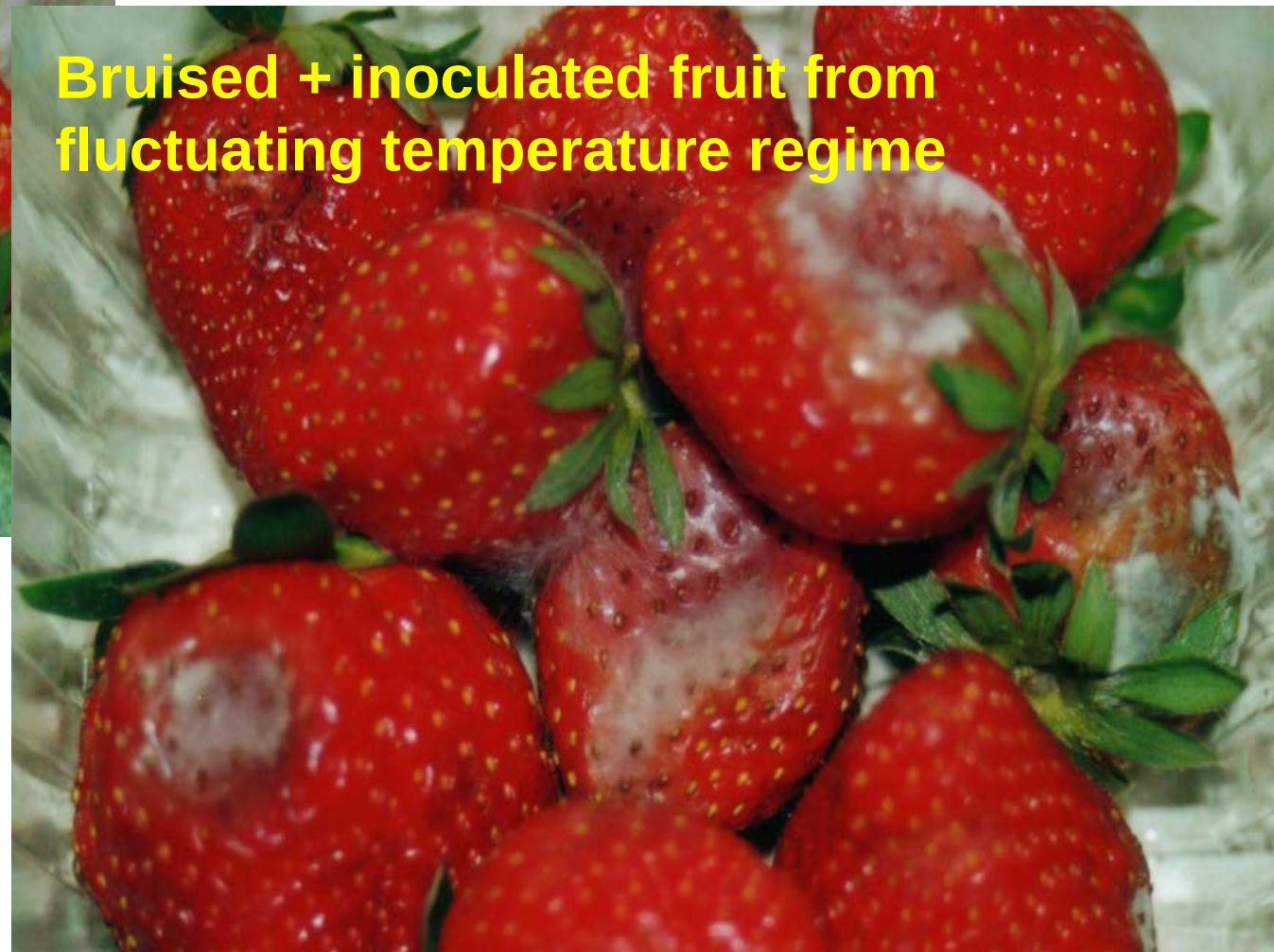





Bruised fruit from semi-constant temperature regime


Bruised fruit from fluctuating temperature regime


Bruised + inoculated fruit from
semi-constant temperature regime


Bruised + inoculated fruit from
fluctuating temperature regime

Strawberry Postharvest Handling Recommendations

1. Harvest in cool parts of the day and protect fruit from direct sun
2. Avoid physical injuries!
3. Handle rapidly: cool quickly, transport and market promptly
4. Avoid water loss – *grocery produce bags work well*
5. Maintain the “cold chain” throughout the postharvest handling period

Thanks for your attention!

Questions?

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IFAS
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