Section 5c

Fresh-cuts and Cell Integrity, Translucency & Juice Leakage

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Absorbent Packaging for Other Fresh-cut Vegetables

Maxwell Chase Technologies

Absorbent Packaging for Diced & Sliced Tomato

Maxwell Chase Technologies

Fresh-cuts & Wound Physiology

- Response depends on the extent or severity of wounding
  - peeling, abrasion, slicing, chopping, and shredding
    - force applied
    - implement sharpness
  - unit size or wounded area
- *Also strongly affected by temperature*

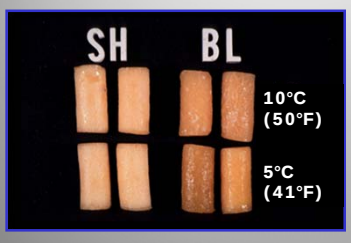
Absorbent Packaging for Fresh-cut Watermelon & Fruit Salad

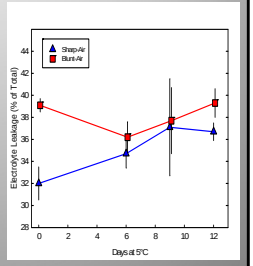
Maxwell Chase Technologies

Melon Translucency

- Differences among melon cultivars
- Probably affected by growing & nutrient conditions

BL = blunt blade
SH = sharp blade





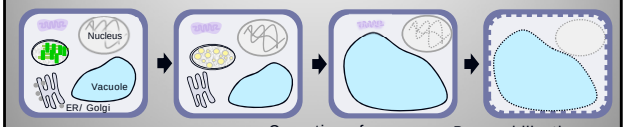
- Translucency does not reduce firmness
- Calcium chloride dips reduce translucency

M. Cantwell, UC Davis

Wound Physiology

- Control depends on:
  - Minimizing the extent or severity of wounding
  - Maintaining low temperature (0-5 ºC)
  - Applying supplemental treatments (primarily antioxidants and firming compounds) to minimize wounding symptoms
  - Handling in modified atmosphere packaging (MAP)

Cellular Death During Senescence



Chlorophyll breakdown, metabolic slowing, induction of proteases, nucleases, lipases

Cessation of protein synthesis and mitochondrial function

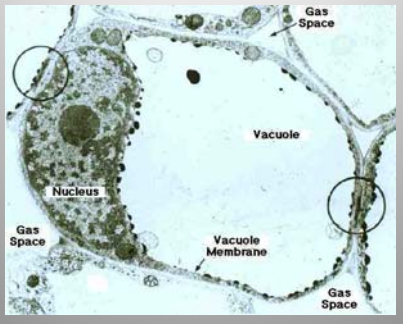
Permeabilization of membranes, death

Fresh-cuts & Chilling Injury

- Chilling injury occurs when a sensitive species is exposed to temperatures below its chilling threshold for sufficient time to cause irreversible injury.
  - For fresh-cut products, the duration of chilling exposure required to cause irreversible injury is rarely, if ever, reached
  - Therefore, 0-5 ºC is the best range
- *Watersoaking is due to Senescence, not chilling Injury*

See: Jeong et al., 2004 and Dea et al., 2010

Cell Contents Leak Into Intercellular Spaces



Koning. 1994. *Plant Physiology Information Website*. http://plantphys.info/

Consequences of Wounding

Induction of ethylene synthesis

10X greater in fruit vs. vegetative tissue

- Increased tissue sensitivity to ethylene
- Ethylene effects:
  - yellowing (chlorophyll degradation)
  - phenolic synthesis (browning, bitter flavor)
  - tissue softening/toughening

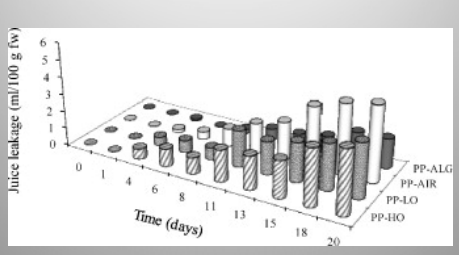
→ *Accelerated senescence*

→ *Accelerated ripening (climacteric fruits)*

Pineapple Translucency

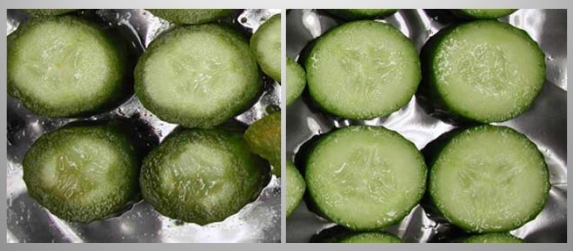
A. Kader, UC Davis

Juice leakage of fresh-cut pineapple pieces stored at 5 °C



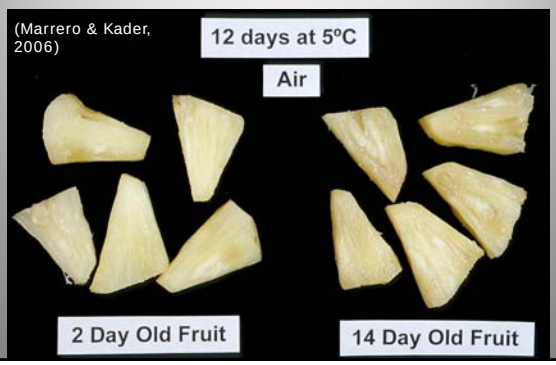
(Montero-Calderon et al.,2008; PBT 60:182.)

Tissue Watersoaking Due to Ethylene Exposure

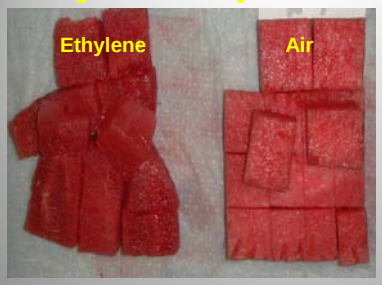


1 ppm Ethylene Air

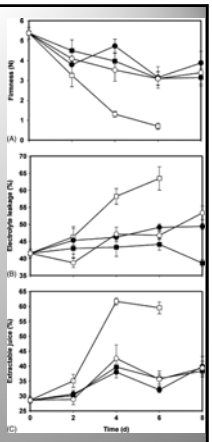
Watersoaking Due to Tissue Senescence



Ethylene Exposure

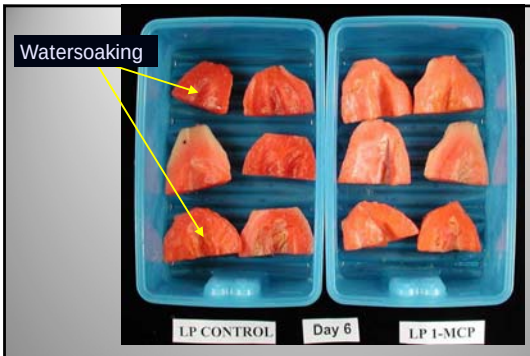


Fresh-cut watermelon following exposure to 1 ppm ethylene (left) or air (right) for 3 d at 10ºC



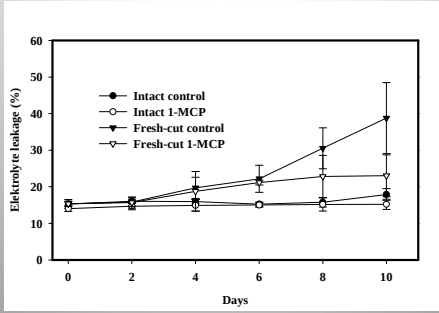
(Mao et al., 2004; 2006)

Zucchini Tissue Breakdown



Fresh-cut ripe 'Sunrise Solo' papaya fruit from either air-treated or 1-MCP (SmartFresh™)-treated fruit stored for 6 days at 5°C.

(Karakurt and Huber)



Electrolyte leakage of intact and fresh-cut ripe 'Sunrise Solo' papaya fruit pre-treated with 1-MCP (SmartFresh™) or air (control) during storage at 5°C

(Ergun et al., 2006)

Consequences of Wounding

Membrane lipid degradation

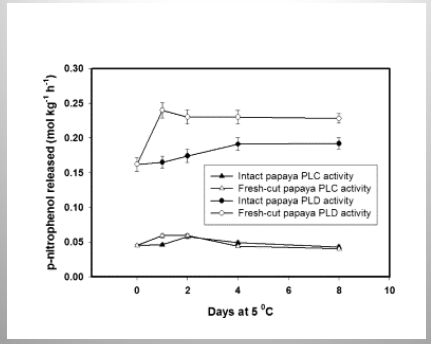
- Phospholipase D (stimulated by ethylene)
  → free fatty acids (substrates of LOX)
- Formation of hydroperoxides
  → free radicals
- Altered membrane protein function
- Increased membrane permeability & ion leakage
  → ***water soaked tissues***

Consequences of Wounding

Oxidative stress

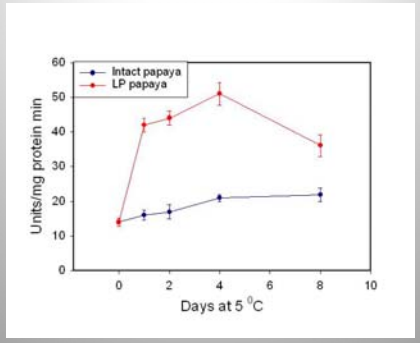
- Rate of formation of reactive O_2 species (ROS) is greater than the rate of their removal
- May be promoted by several other stresses, *e.g.*, temperature extremes, UV, salt, drought, hypoxia, and wounding

→Hydroxyl radicals, peroxidized lipids, damage to membranes, proteins, and nucleic acids



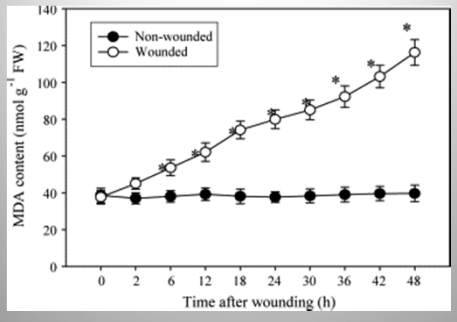
Phospholipase C (below) and D (above) activities in intact and fresh-cut (LP) papaya fruit stored for 8 d at 5°C.

(Karakurt and Huber, 2003)



Lipoxygenase activity in intact and fresh-cut (LP) papaya fruit stored for 8 d at 5°C.

(Karakurt and Huber, 2003)



Malondialdehyde (MDA) in intact and wounded (15-mm thick slices) banana fruit stored for 48 h at 22°C.

(Chen et al., 2009)

Fresh-cut Tomato Watersoaking

Fresh-cut: (4 d at 5˚C)
water-soaked area in tomato slices

(Jeong et al.)

Thank you for your attention

Fresh-cut Tomato Watersoaking

Fresh-cut tomato
(light red stage)

8 days at
5°C

Fresh-cut tomato
(red stage)

8 days at
5°C

Jeong et al. 2003

How To Reduce Watersoaking

1. Start with fresh whole products at optimum maturity
2. Process at low temperature (<5°C) using sharp blades
3. Rinse cut surfaces (sanitizer, calcium, antioxidant solutions)
4. Maintain cold chain throughout handling