**Fresh-cuts and Cell Integrity, Translucency & Juice Leakage**

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**Absorbent Packaging for Diced & Sliced Tomato**

**Absorbent Packaging for Fresh-cut Watermelon & Fruit Salad**

**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

**Melon Translucency**
- Differences among melon cultivars
- Probably affected by growing & nutrient conditions
- Translucency does not reduce firmness
- Calcium chloride dips reduce translucency

***SH = sharp blade  BL = blunt blade***
**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)

**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

**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)**

**Cellular Death During Senescence**

- Chlorophyll breakdown, metabolic slowing, induction of proteases, nucleases, lipases
- Cessation of protein synthesis and mitochondrial function
- Permeabilization of membranes, death

**Cell Contents Leak Into Intercellular Spaces**


**Pineapple Translucency**

- A. Kader, UC Davis
Juice leakage of fresh-cut pineapple pieces stored at 5 °C

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

Watersoaking Due to Tissue Senescence

(Marrero & Kader, 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.

(Ethylene Exposure)

(Mao et al., 2004; 2006)

Tissue Watersoaking Due to Ethylene Exposure

1 ppm Ethylene

Air

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

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**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)

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**Consequences of Wounding**

**Oxidative stress**
- Rate of formation of reactive O₂ 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, peroxized lipids, damage to membranes, proteins, and nucleic acids

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**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)

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

(Karakurt and Huber, 2003)

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**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

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

Thank you for your attention