Recent Developments to Maintain Overall Sweet Cherry Quality During Postharvest Storage

Prof. Dr. Daniel Valero

University Miguel Hernández, Alicante   SPAIN

E-mail: daniel.valero@umh.es
Introduction

Cherry Fruit Growth and Ripening

Cherry Quality and Composition

Postharvest Quality Deterioration

Innovative Tools to Maintain Quality

1. Preharvest Treatments.

2. Postharvest Treatments

Conclusions
Introduction

Main Production Areas

Year 2012

105000 tones

1. Turkey
2. USA
3. Iran
4. China
5. Italy
6. Spain
7. Russia
8. Romania
9. Chile
Introduction

Year 2012
22600 tones

<table>
<thead>
<tr>
<th>MARKET</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>% VAR 13VS12</th>
<th>% PART. 2012</th>
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<tbody>
<tr>
<td>EUROPE CONTINENT</td>
<td>17,553</td>
<td>13,896</td>
<td>15,492</td>
<td>14,595</td>
<td>11%</td>
<td>65%</td>
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<tr>
<td>UNITED KINGDOM</td>
<td>8,452</td>
<td>9,029</td>
<td>11,822</td>
<td>5,674</td>
<td>31%</td>
<td>25%</td>
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<tr>
<td>RUSSIA</td>
<td>603</td>
<td>496</td>
<td>1,751</td>
<td>2,084</td>
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<td>9%</td>
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<tr>
<td>ASIA</td>
<td>45</td>
<td>125</td>
<td>118</td>
<td>104</td>
<td>-6%</td>
<td>0%</td>
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<tr>
<td>LATIN AMERICA</td>
<td>8</td>
<td>3</td>
<td>13</td>
<td>20</td>
<td>333%</td>
<td>0%</td>
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<tr>
<td>OTHERS</td>
<td>1,063</td>
<td>867</td>
<td>1,271</td>
<td>146</td>
<td>47%</td>
<td>1%</td>
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<tr>
<td>TOTAL</td>
<td>15,845</td>
<td>27,724</td>
<td>24,416</td>
<td>22,623</td>
<td>-7%</td>
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</table>
Cherry Fruit Growth and Ripening

A relationship between percentage of pit weight with respect to fruit weight and final fruit weight.
Cherry Fruit Growth and Ripening

Important Increases of Ethylene during On-Tree Ripening

Days after full blossom
25 30 35 40 45 50 55 60 65
Ethylene production (nL g⁻¹ h⁻¹)
0.5
1.0
1.5
Phase I Phase II Phase III
-Brooks
Cristalina
Sonata
End Cell Division and Initial Cell Enlargement
After Pit Hardening
Onset of Ripening
Cherry Fruit Growth and Ripening

Sonata cultivar

Cherry Fruit Growth and Ripening

Important Differences among cultivars. Colour At Harvest

Cherry Fruit Growth and Ripening

Anthocyanins start to accumulate at the latest growth stages

A good correlation was found between colour a/b and anthocyanin content

Cherry Quality and Composition

Cherries, sweet, red, raw

Nutritional value per 100 g (3.5 oz)

<table>
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<tr>
<th>Energy</th>
<th>263 kJ (63 kcal)</th>
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<tr>
<td>Carbohydrates</td>
<td>16 g</td>
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<tr>
<td>Sugars</td>
<td>12.8 g</td>
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<tr>
<td>Dietary fiber</td>
<td>2.1 g</td>
</tr>
<tr>
<td>Fat</td>
<td>0.2 g</td>
</tr>
<tr>
<td>Protein</td>
<td>1.1 g</td>
</tr>
<tr>
<td>Vitamins</td>
<td></td>
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<tr>
<td>Vitamin A equiv.</td>
<td>3 μg (0%)</td>
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<tr>
<td>beta-carotene</td>
<td>38 μg (0%)</td>
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<tr>
<td>Lutein zeaxanthin</td>
<td>85 μg</td>
</tr>
<tr>
<td>Thiamine (B₁)</td>
<td>0.027 mg (2%)</td>
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<tr>
<td>Riboflavin (B₂)</td>
<td>0.033 mg (3%)</td>
</tr>
<tr>
<td>Niacin (B₃)</td>
<td>0.154 mg (1%)</td>
</tr>
<tr>
<td>Pantothenic acid (B₅)</td>
<td>0.199 mg (4%)</td>
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<tr>
<td>Vitamin B₆</td>
<td>0.049 mg (4%)</td>
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<tr>
<td>Folate (B₉)</td>
<td>4 μg (1%)</td>
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<tr>
<td>Choline</td>
<td>6.1 mg (1%)</td>
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<tr>
<td>Vitamin C</td>
<td>7 mg (8%)</td>
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<tr>
<td>Vitamin K</td>
<td>2.1 μg (2%)</td>
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<tr>
<td>Trace metals</td>
<td></td>
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<tr>
<td>Calcium</td>
<td>13 mg (1%)</td>
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<tr>
<td>Iron</td>
<td>0.36 mg (3%)</td>
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<tr>
<td>Magnesium</td>
<td>11 mg (3%)</td>
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<tr>
<td>Manganese</td>
<td>0.07 mg (3%)</td>
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<tr>
<td>Phosphorus</td>
<td>21 mg (3%)</td>
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<tr>
<td>Potassium</td>
<td>222 mg (5%)</td>
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<tr>
<td>Sodium</td>
<td>0 mg (0%)</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.07 mg (1%)</td>
</tr>
</tbody>
</table>

Cherry Quality and Composition

Important Content of Bioactive Compounds with Antioxidant Activity

**Phenolic compounds**

- Hydroxybenzoic acids
  - Ellagic acid
  - Gallic acid
- Hydroxycinnamates
  - Neochlorogenic acid
  - p-Coumaroylquinic acid
  - Chlorogenic acid
- Flavonoids
  - Flavanols
  - Flavan-3-ols
  - Anthocyanins

González-Gómez, D. 2013. 7th International Cherry Symposium, Plasencia, Spain
Cherry Quality and Composition

Anthocyanins

<table>
<thead>
<tr>
<th>Individual Anthocyanin (mg 100 g⁻¹)</th>
<th>Cyanidin 3-glucoside</th>
<th>Cyanidin 3-rutinoside</th>
<th>Pelargonidin 3-rutinoside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet Heart</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Sweet Late</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Flavonols

<table>
<thead>
<tr>
<th>Individual Flavonol (mg 100 g⁻¹)</th>
<th>Myricetin 3-rutinoside</th>
<th>Kaempferol 3-rutinoside</th>
<th>Quercetin 3-rutinoside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet Heart</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Sweet Late</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Cherry Quality and Composition

Hydroxycinnamic acids

Cherry Quality and Composition

Reason for Liking Cherry

- Sweetness: 65%
- Juicines: 14%
- Firmness: 14%
- Skin Colour: 3%
- Sourness: 5%
- Texture: 2%

Reason for Disliking Cherry

- Lack of Flavour: 27%
- Too Sour: 27%
- Lack of Juicines: 8%
- Lack of Sweetness: 15%
- Not Sour Enough: 4%
- Soft Texture: 15%

Long, L.E. 2013. 7th International Cherry Symposium, Plasencia, Spain
Postharvest Quality Deterioration

QUALITY

↓

RIPENING INDEX

↓

OPTIMUM DATE FOR

HARVESTING
Postharvest Quality Deterioration

- Respiration Rate
- Transpiration – Water Loss
- Firmness - Softening
- Colour - Darkening
- Aroma - Flavour
- Nutrients: Vitamins

Over-Ripening
Fungal Decay
Reduced Shelf-Life
Innovative Tools to Maintain Quality

1. Preharvest Treatments

2. Postharvest Treatments

1. Oxalic Acid (OA)
2. Salicylic Acid (SA)
3. Acetylsalicylic Acid (ASA)
4. Methyl Salicylate (MeSA)
5. Methyl Jasmonate (MeJA)
Innovative Tools to Maintain Quality

- **Volatile organic compounds released by plants**
  - 1000 tera-grams of carbon per year for terpenoids
  - e.g. essential oil in rose petals ~0.02–0.03% of plant’s weight
Innovative Tools to Maintain Quality

**Oxalic Acid (OA)**

- **Oxalic acid** is present in many plants naturally (as a final metabolite): Natural organic anion
- Inducing of Systemic Acquired Resistance (SAR)
- OA delays *ripening*: mango, plum, peach
- Postharvest OA: Reduces Chilling Injury (pomegranate, mango, peach)
- Controlling tissue *fruit browning*
- Natural antioxidant: *suppressing lipid peroxidation*
Innovative Tools to Maintain Quality

Salicylic Acid (SA)

- Since initial discover: Identified in many plants
- Salicylic acid is a naturally occurring plant hormone involved in plant protection
- SA acts as a signal molecule related to defence responses: Provides protection from pathogen attack
- Postharvest SA: Decreased Decay, Chilling Injury and Retarded Ripening (tomato, pomegranate, mango, plum, peach)
- Dietary salicylates: Induce health benefits
Innovative Tools to Maintain Quality

**Acetylsalicylic Acid (SA)**

- A close analogue of SA
- When applied exogenously is converted to SA spontaneously
- Involving in *fruit ripening* through increasing SA
- ASA has *similar effects* to SA in plant defence processes
- Postharvest ASA: Decreased *Chilling Injury* and Retarded Ripening (pomegranate, kiwifruit)
Methyl Salicylate (MeSA)

- MeSA is a volatile synthetized from SA and when applied exogenously is converted to SA spontaneously.
- MeSA has similar effects to SA in plant defence processes.
- Postharvest MeSA: Involved in Reducing Chilling Injury (Pomegranate)

\[
\text{SALICYLIC ACID + CH}_3\text{OH} \rightarrow \text{METHYL SALICYLATE + H}_2\text{O}
\]
Innovative Tools to Maintain Quality

**Methyl Jasmonate (MeJA)**

- Volatile JA derivative
- Induces synthesis of protease inhibitors
- Induces accumulation of other chemicals involved in plant defence
- Promotes pigmentation (red apples)
- Potential in *pest* management
  - Low concentrations
- **Postharvest MeJA:**
  - Involved in reducing Cl
  - Accelerates / Retards Ripening
Preharvest Treatments. Experimental

- **Early Lori**
- **Sweet Heart**
- **Sweet Late**

5 Trees / Treatment | 4 Litres / Tree

1. **Oxalic Acid (OA)**
2. **Salicylic Acid (SA)**
3. **Acetylsalicylic Acid (ASA)**
4. **Methyl Salicylate (MeSA)**
5. **Methyl Jasmonate (MeJA)**

0 (Control) | 0.5 mM | 1.0 mM | 2.0 mM

- T1 – 98 DAFB
- T2 – 112 DAFB
- T3 – 126 DAFB
Preharvest Treatments.  

Oxalic Acid (OA)

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**'Sweet Heart'**

- Days After Full Blossom: 91, 98, 105, 112, 119, 126, 133, 138
- Fruit Volume (mm³): 2000, 4000, 6000, 8000
- Treatments: Control, OA 0.5 mM, OA 1.0 mM, OA 2.0 mM

**'Sweet Late'**

- Days After Full Blossom: 91, 98, 105, 112, 119, 126, 133, 140, 145
- Fruit Volume (mm³): 2000, 4000, 6000, 8000
- Treatments: Control, OA 0.5 mM, OA 1.0 mM, OA 2.0 mM
<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Control</th>
<th>OA (0.5 mM)</th>
<th>OA (1.0 mM)</th>
<th>OA (2.0 mM)</th>
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</thead>
<tbody>
<tr>
<td><strong>Fruit Weight (g)</strong></td>
<td></td>
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</tr>
<tr>
<td>Sweet Heart</td>
<td>6.77 ± 0.13 a</td>
<td>7.73 ± 0.25 b</td>
<td>7.94 ± 0.24 b</td>
<td>8.02 ± 0.12 b,c</td>
</tr>
<tr>
<td>Sweet Late</td>
<td>6.62 ± 0.14 a</td>
<td>7.89 ± 0.15 b</td>
<td>8.14 ± 0.26 b</td>
<td>8.64 ± 0.32 c</td>
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<tr>
<td><strong>Firmness (N mm⁻¹)</strong></td>
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<tr>
<td>Sweet Heart</td>
<td>3.09 ± 0.09 a</td>
<td>3.44 ± 0.09 b</td>
<td>3.66 ± 0.11 c</td>
<td>3.70 ± 0.11 c</td>
</tr>
<tr>
<td>Sweet Late</td>
<td>2.61 ± 0.09 a</td>
<td>2.84 ± 0.10 b</td>
<td>2.96 ± 0.10 b</td>
<td>3.54 ± 0.07 c</td>
</tr>
<tr>
<td><em><em>Color (a</em>/b</em>)**</td>
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</tr>
<tr>
<td>Sweet Heart</td>
<td>2.82 ± 0.09 a</td>
<td>3.02 ± 0.07 b</td>
<td>3.10 ± 0.12 b</td>
<td>3.21 ± 0.10 b,c</td>
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<td>Sweet Late</td>
<td>3.19 ± 0.11 a</td>
<td>3.44 ± 0.10 b</td>
<td>3.34 ± 0.16 b</td>
<td>3.46 ± 0.14 b</td>
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<td><strong>TSS (g 100 g⁻¹)</strong></td>
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<tr>
<td>Sweet Heart</td>
<td>19.95 ± 0.09 a</td>
<td>19.40 ± 0.11 a</td>
<td>20.75 ± 0.35 b</td>
<td>20.88 ± 0.08 b</td>
</tr>
<tr>
<td>Sweet Late</td>
<td>19.05 ± 0.20 a</td>
<td>19.43 ± 0.21 a</td>
<td>19.60 ± 0.12 a,b</td>
<td>19.88 ± 0.18 b,a</td>
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<td><strong>TA (g 100 g⁻¹)</strong></td>
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<tr>
<td>Sweet Heart</td>
<td>1.50 ± 0.01 a</td>
<td>1.59 ± 0.05 b</td>
<td>1.63 ± 0.02 b</td>
<td>1.59 ± 0.04 b</td>
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<tr>
<td>Sweet Late</td>
<td>1.35 ± 0.01 a</td>
<td>1.41 ± 0.04 b</td>
<td>1.42 ± 0.02 b</td>
<td>1.54 ± 0.02 c</td>
</tr>
</tbody>
</table>

**OA-Treated fruit:**  Higher Weight and Size, Firmness and Acidity. No effect on TSS. 2 mM OA being the most effective.
Preharvest Treatments. Oxalic Acid (OA)

2 mM OA-Treated fruit: Higher Phenolics, Anthocyanins and Antioxidant Activity: H-TAA and L-TAA.
Preharvest Treatments. SA and ASA

Sweet Heart

Days After Full Blossom

<table>
<thead>
<tr>
<th>Days</th>
<th>91</th>
<th>98</th>
<th>105</th>
<th>112</th>
<th>119</th>
<th>126</th>
<th>133</th>
<th>138</th>
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</thead>
<tbody>
<tr>
<td>Fruit Volume (mm$^3$)</td>
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<td>2000</td>
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<td>4000</td>
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<td>Control</td>
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<tr>
<td>ASA 0.5 mM</td>
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<td>ASA 1.0 mM</td>
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<td>ASA 2.0 mM</td>
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</table>

Sweet Late

Days After Full Blossom

<table>
<thead>
<tr>
<th>Days</th>
<th>91</th>
<th>98</th>
<th>105</th>
<th>112</th>
<th>119</th>
<th>126</th>
<th>133</th>
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<tbody>
<tr>
<td>Fruit Volume (mm$^3$)</td>
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<td>Control</td>
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<td>ASA 0.5 mM</td>
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<td>ASA 1.0 mM</td>
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<td>ASA 2.0 mM</td>
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<tr>
<td>SA 0.5 mM</td>
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<tr>
<td>SA 1.0 mM</td>
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Sweet Heart
0.5 mM SA and 1.0 mM ASA

Sweet Late
Preharvest Treatments. SA and ASA

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Control</th>
<th>ASA</th>
<th>SA</th>
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</thead>
<tbody>
<tr>
<td>'Sweet Heart'</td>
<td>0.5 mM</td>
<td>1 mM</td>
<td>2 mM</td>
</tr>
<tr>
<td>'Sweet Late'</td>
<td>0.5 mM</td>
<td>1 mM</td>
<td>2 mM</td>
</tr>
</tbody>
</table>

Treated fruit:
- Higher Colour a/b Parameter
# Preharvest Treatments

**SA and ASA**

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Firmness</th>
<th>TSS</th>
<th>TA</th>
<th>Respiration rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>‘Sweet Heart’</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>6.77 ± 0.13 a</td>
<td>2.95 ± 0.15 a</td>
<td>19.82 ± 0.11 a</td>
<td>1.48 ± 0.10 a</td>
<td>20.62 ± 1.63 a</td>
</tr>
<tr>
<td>SA (0.5 mM)</td>
<td>7.64 ± 0.14 b</td>
<td>3.87 ± 0.08 b</td>
<td>20.83 ± 0.06 b</td>
<td>1.50 ± 0.08 a</td>
<td>22.14 ± 1.40 a</td>
</tr>
<tr>
<td>SA (1.0 mM)</td>
<td>7.13 ± 0.15 c</td>
<td>3.43 ± 0.13 c</td>
<td>20.00 ± 0.32 a</td>
<td>1.45 ± 0.09 a</td>
<td>20.27 ± 0.54 a</td>
</tr>
<tr>
<td>SA (2.0 mM)</td>
<td>7.38 ± 0.13 bc</td>
<td>3.52 ± 0.10 c</td>
<td>18.85 ± 0.23 c</td>
<td>1.56 ± 0.08 a</td>
<td>22.77 ± 1.17 a</td>
</tr>
<tr>
<td>ASA (0.5 mM)</td>
<td>7.52 ± 0.06 b</td>
<td>3.37 ± 0.09 c</td>
<td>19.50 ± 0.55 a</td>
<td>1.49 ± 0.12 a</td>
<td>19.48 ± 2.13 a</td>
</tr>
<tr>
<td>ASA (1.0 mM)</td>
<td>8.34 ± 0.09 d</td>
<td>3.39 ± 0.09 c</td>
<td>20.13 ± 0.12 a</td>
<td>1.58 ± 0.07 a</td>
<td>20.73 ± 1.02 a</td>
</tr>
<tr>
<td>ASA (2.0 mM)</td>
<td>7.83 ± 0.22 b</td>
<td>2.73 ± 0.10 a</td>
<td>19.30 ± 0.21 a</td>
<td>1.60 ± 0.09 a</td>
<td>18.06 ± 1.33 a</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Firmness</th>
<th>TSS</th>
<th>TA</th>
<th>Respiration rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>‘Sweet Late’</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>6.62 ± 0.24 a</td>
<td>3.01 ± 0.05 a</td>
<td>20.01 ± 0.20 a</td>
<td>1.39 ± 0.09 a</td>
<td>9.66 ± 0.64 a</td>
</tr>
<tr>
<td>SA (0.5 mM)</td>
<td>9.08 ± 0.21 b</td>
<td>3.63 ± 0.14 b</td>
<td>19.65 ± 0.16 a</td>
<td>1.45 ± 0.11 a</td>
<td>10.21 ± 0.56 a</td>
</tr>
<tr>
<td>SA (1.0 mM)</td>
<td>8.71 ± 0.14 b</td>
<td>3.43 ± 0.07 b</td>
<td>19.45 ± 0.38 a</td>
<td>1.46 ± 0.09 a</td>
<td>10.97 ± 0.43 a</td>
</tr>
<tr>
<td>SA (2.0 mM)</td>
<td>8.55 ± 0.08 c</td>
<td>3.21 ± 0.11 a</td>
<td>17.33 ± 0.47 b</td>
<td>1.49 ± 0.08 a</td>
<td>9.24 ± 0.13 a</td>
</tr>
<tr>
<td>ASA (0.5 mM)</td>
<td>7.30 ± 0.08 c</td>
<td>3.46 ± 0.08 b</td>
<td>19.53 ± 0.62 a</td>
<td>1.46 ± 0.09 a</td>
<td>10.63 ± 0.98 a</td>
</tr>
<tr>
<td>ASA (1.0 mM)</td>
<td>9.19 ± 0.18 b</td>
<td>3.81 ± 0.18 c</td>
<td>21.63 ± 0.22 c</td>
<td>1.44 ± 0.08 a</td>
<td>9.46 ± 0.48 a</td>
</tr>
<tr>
<td>ASA (2.0 mM)</td>
<td>8.83 ± 0.23 b</td>
<td>3.64 ± 0.11 b</td>
<td>18.28 ± 0.16 d</td>
<td>1.44 ± 0.07 a</td>
<td>9.74 ± 1.88 a</td>
</tr>
</tbody>
</table>

**SA,ASA-Treated fruit:** Higher Weight and Firmness. TSS Higher 0.5 SA and 1.0 ASA
Preharvest Treatments. SA and ASA

0.5 SA, 1.0 ASA-Treated fruit: Higher Anthocyanins. Correlation with H-TAA.

Treated fruit: Higher Phenolics, and Antioxidant Activity: H-TAA

No effect on L-TAA

'Sweet Heart'

'Sweet Late'

Total Anthocyanins (mg CGE 100 g⁻¹)

Days After Full Blossom

Control
ASA 1 mM
SA 0.5 mM

y = 1.79 x + 49.87; R²=0.919

y = 1.89 + 10.03; R²=0.864
Preharvest Treatments.

Methyl Salicylate (MeSA)

- MeSA at 2.0 mM: Higher Fruit Weight and Firmness
- Colour a/b parameter higher in Treated Fruit
- At harvest Acidity was greater with 2.0 mM
- No effect on TSS
- Higher content of Total Phenolics, Total Anthocyanins and Total Antioxidant Activity, both H-TAA and L-TAA.
Preharvest Treatments.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>MeSA</th>
<th>ASA</th>
<th>SA</th>
<th>OA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>600</td>
<td>800</td>
<td>1000</td>
<td>1200</td>
<td>0</td>
</tr>
<tr>
<td>0.5 mM</td>
<td>0.5</td>
<td>1</td>
<td>2</td>
<td>23%</td>
<td>33%</td>
</tr>
<tr>
<td>1.0 mM</td>
<td>10%</td>
<td>39%</td>
<td>38%</td>
<td>23%</td>
<td>29%</td>
</tr>
<tr>
<td>2.0 mM</td>
<td>37%</td>
<td>6%</td>
<td>9%</td>
<td>32%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Increase Yield respect to Control

Sweet Late

Fruit Weight (g) per 100 Cherries

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>MeSA</th>
<th>ASA</th>
<th>SA</th>
<th>OA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>600</td>
<td>800</td>
<td>1000</td>
<td>1200</td>
<td>0</td>
</tr>
<tr>
<td>0.5 mM</td>
<td>0.5</td>
<td>1</td>
<td>2</td>
<td>23%</td>
<td>33%</td>
</tr>
<tr>
<td>1.0 mM</td>
<td>10%</td>
<td>39%</td>
<td>38%</td>
<td>23%</td>
<td>29%</td>
</tr>
<tr>
<td>2.0 mM</td>
<td>37%</td>
<td>6%</td>
<td>9%</td>
<td>32%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Increase Yield respect to Control

Sweet Heart

Fruit Weight (g) per 100 Cherries

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>MeSA</th>
<th>ASA</th>
<th>SA</th>
<th>OA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>600</td>
<td>800</td>
<td>1000</td>
<td>1200</td>
<td>0</td>
</tr>
<tr>
<td>0.5 mM</td>
<td>0.5</td>
<td>1</td>
<td>2</td>
<td>23%</td>
<td>33%</td>
</tr>
<tr>
<td>1.0 mM</td>
<td>10%</td>
<td>39%</td>
<td>38%</td>
<td>23%</td>
<td>29%</td>
</tr>
<tr>
<td>2.0 mM</td>
<td>37%</td>
<td>6%</td>
<td>9%</td>
<td>32%</td>
<td>9%</td>
</tr>
</tbody>
</table>
Preharvest Treatments.

Data just “baked” May 27 2014 ‘Lapins’

**Fruit Weight (g) per 100 Cherries**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>MeSA</th>
<th>ASA</th>
<th>SA</th>
<th>OA</th>
<th>MeJA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 mM</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>1.0 mM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0 mM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fruit Diameter (mm)**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>MeSA</th>
<th>ASA</th>
<th>SA</th>
<th>OA</th>
<th>MeJA</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
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<td>26</td>
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<td></td>
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</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 mM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 mM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0 mM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Preharvest Treatments. Methyl Jasmonate (MeJA)

![Graphs showing the effects of MeJA on fruit volume, weight, colour, and TSS over time.]

- **Fruit Volume (mm³):**
  - Control
  - MeJA 0.5 mM
  - MeJA 1.0 mM
  - MeJA 2.0 mM

- **Fruit Weight (g):**
  - Control
  - MeJA 0.5 mM
  - MeJA 1.0 mM
  - MeJA 2.0 mM

- **Colour (a*/b*):**
  - Control
  - MeJA 0.5 mM
  - MeJA 1.0 mM
  - MeJA 2.0 mM

- **TSS (°Brix):**
  - Control
  - MeJA 0.5 mM
  - MeJA 1.0 mM
  - MeJA 2.0 mM
Preharvest Treatments. Postharvest Storage

Days at 2°C + 1 Day at 20°C

Days at 2°C + 1 Day at 20°C

Color (a/b)

Control
OA 2.0 mM
SA 0.5 mM
ASA 1.0 mM
MeSA 2.0 mM

'Sweet Heart'

'Sweet Late'
Preharvest Treatments. Postharvest Storage

Days at 2°C + 1 Day at 20°C

Fruit Firmness (N mm\(^{-1}\))

- **Control**
- OA 2.0 mM
- SA 0.5 mM
- ASA 1.0 mM
- MeSA 2.0 mM

'Sweet Heart'

'Sweet Late'

Fruit Firmness (N mm\(^{-1}\))

- **Control**
- OA 2.0 mM
- SA 0.5 mM
- ASA 1.0 mM
- MeSA 2.0 mM

Days at 2°C + 1 Day at 20°C
<table>
<thead>
<tr>
<th></th>
<th>TSS</th>
<th>TA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>‘Sweet Heart’</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 0</td>
<td>19.95±0.09 Aa</td>
<td>20.88±0.08 Aa</td>
</tr>
<tr>
<td>Day 28</td>
<td>19.88±0.22 Aa</td>
<td>21.25±0.21 Aa</td>
</tr>
<tr>
<td><strong>‘Sweet Late’</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 0</td>
<td>20.01±0.19 Aa</td>
<td>19.43±0.21 Aa</td>
</tr>
<tr>
<td>Day 28</td>
<td>20.95±0.31 Aa</td>
<td>21.77±0.64 Aa</td>
</tr>
<tr>
<td><strong>‘Sweet Heart’</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 0</td>
<td>1.50±0.04 Aa</td>
<td>1.54±0.04 Aa</td>
</tr>
<tr>
<td>Day 28</td>
<td>1.36±0.02 Ba</td>
<td>1.46 ±0.02 Ab</td>
</tr>
<tr>
<td><strong>‘Sweet Late’</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 0</td>
<td>1.48±0.02 Aa</td>
<td>1.53±0.04 Aa</td>
</tr>
<tr>
<td>Day 28</td>
<td>1.35±0.01 Bb</td>
<td>1.41 ±0.03 Ba</td>
</tr>
</tbody>
</table>

**Notes:**
- The table shows pre-harvest treatments and postharvest storage control for two varieties: ‘Sweet Heart’ and ‘Sweet Late’.
- The table compares TSS (Total Soluble Solids) and TA (Total Acid) levels.
- Data includes values for Day 0 and Day 28 post-harvest.
- Values are expressed as mean ± standard error.
- Abbreviations: OA (Oxalic Acid), SA (Salicylic Acid), ASA (Ascorbic Acid), MeSA (Methyl Salicylate).
- Letters (A, B) indicate statistical significance at the 0.05 level using the Tukey test.
Application of OA, SA, ASA, MeSA and MeJA at 3 key dates increased Fruit Size and Weight. Treated fruit had higher Firmness and Acidity.

No dose-dependence effect was observed

The content of bioactive compounds (Phenolics, Anthocyanins) and Antioxidant Activity (H-TAA) was enhanced at Harvest.

MeJA treatment increased sweet cherry Colour and TSS.

Quality of treated cherries was maintained during cold postharvest storage (Colour and Firmness) and TSS and TA (ASA at 1 mM and MeSA at 2 mM)
Postharvest Treatments. Experimental

- SA 1 mM
- ASA 1 mM
- OA 1 mM
Postharvest Treatments. Experimental

Early Lori

- MeSA 0.1 mM
- MeSA 1.0 mM
- MeJA 0.1 mM
- MeJA 1.0 mM

Treatments: 16 h at 20°C
Postharvest Treatments.

Postharvest Treatments. (SA, ASA, OA)

Postharvest Treatments.

(SA, ASA, OA)

<table>
<thead>
<tr>
<th>Days at 2°C</th>
<th>Total Anthocyanins (mg 100 g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>120</td>
</tr>
<tr>
<td>15</td>
<td>140</td>
</tr>
<tr>
<td>20</td>
<td>160</td>
</tr>
</tbody>
</table>

Control
SA 1 mM
ASA 1 mM
OA 1 mM

Prime Giant

LSD = 0.80
Postharvest Treatments. (SA, ASA, OA)

### Cristalina

- Control
- SA 1 mM
- ASA 1 mM
- OA 1 mM

**Total Carotenoids (mg 100 g⁻¹)**

- LSD = 0.05

### Prime Giant

- Control
- SA 1 mM
- ASA 1 mM
- OA 1 mM

**Total Carotenoids (mg 100 g⁻¹)**

- LSD = 0.09

Days at 2°C

- 0
- 5
- 10
- 15
- 20

Total Carotenoids (mg 100 g⁻¹)

- 0.6
- 0.8
- 1.0
- 1.2
- 1.4
- 1.6

Control

SA 1 mM

ASA 1 mM

OA 1 mM

Prime Giant Cristalina

LSD = 0.05

LSD = 0.09

Days at 2°C

- 0
- 5
- 10
- 15
- 20

Total Carotenoids (mg 100 g⁻¹)

- 0.5
- 1.0
- 1.5
- 2.0
- 2.5

Control

SA 1 mM

ASA 1 mM

OA 1 mM

Prime Giant

LSD = 0.09
Postharvest Treatments.

(MeSA)

Treated fruit:
- Reduced Softening
- Acidity Retention
- Lower Respiration Rate
- No effect on TSS and Colour
Postharvest Treatments.

(MeJA)

Treated fruit:
- Reduced Softening
- Acidity Retention
- Lower Respiration Rate
- No effect on Colour and TSS

![Graphs showing fruit firmness, total acidity, and ripening index over days of storage at 2°C for different treatments.]

**Fruit Firmness (N mm⁻¹)**
- Control
- MeJA 1 mM
- MeJA 0.1 mM

**Total Acidity (g 100 g⁻¹)**
- Control
- MeJA 1 mM
- MeJA 0.1 mM

**Ripening Index (TSS / TA)**
- Control
- MeJA 1 mM
- MeJA 0.1 mM
Postharvest Treatments. Conclusions

- Postharvest application of OA, SA, ASA, MeSA and MeJA on sweet cherry cultivars delayed Ripening and maintained Quality Attributes.

- MeSA at 0.1 mM and MeJA at 1mM showed the best results in terms of quality maintenance.

- The content of bioactive compounds (Phenolics, Anthocyanins and Carotenoids) and Antioxidant Activity (H-TAA and L-TAA) were higher at the end of storage (20 days at 2°C).
Acknowledgements

PROJECT AGL2012-35402
MINISTRY OF ECONOMY AND COMPETITIVITY

TITLE:
Ripening control and induction of the defense and antioxidant systems through new pre- and postharvest treatments on plum and sweet cherry cultivars
The Postharvest Team at UMH

University Miguel Hernández, Alicante SPAIN

THANKS FOR YOUR ATTENTION!!!!!
2nd Round Vice-Chair Postharvest Commission

Deadline for this (second) voting round is June 20, 2014

This ballot is for Commissions only. To vote for a Section Vice-chairperson use the http://www.ishs.org/elections-ballot-sections instead. http://www.ishs.org/elections

Your name *

Your membership number *

Unique voting reference code *

Select a Candidate *

Prof. Dr. Daniel Valero (CMPH)

Submit

THANKS FOR YOUR VOTE!!!!!