Improve quality to increase consumption

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COST Action 104 “Sustainable production of high-quality cherries for the European market”
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Problems:
Regional producers tend to harvest cherries sooner in order to increase their profits. They don’t storage cherries at all.

Goals:
To test the effect of different ripening stages at the moment of harvesting on fruit quality.
Understanding the influence of different ripening stages at the moment of harvesting on changes in quality and nutritional aspects of cherries during cold storage.
Select different storage methods considering nutritional properties

• 1\textsuperscript{st} Quality Evaluation of ‘Sunburst’ Cherries Harvested at Different Ripeness Stages.
• 2\textsuperscript{nd} Storage of ‘Sunburst’ Cherries Harvested at Different Ripeness Stages.
• 3\textsuperscript{rd} Effect of Different Storage Conditions on Nutritional and Quality Parameters of ‘Sweetheart’ Cherry.
• 4\textsuperscript{th} Evolution of Phenolic compounds in ‘Sweetheart’ sweet cherries considering different postharvest conditions.
Skin colour is the most important indicator of quality and maturity of fresh cherry and depends on the anthocyanin content.

Anthocyanin pigments are responsible for the attractive colours of many fruits.

Different varieties characterized by very different skin colours!

And also consumers point of view.

1st Appearance – colour, caliber and shape;
2nd TSS/TA
3rd Texture
Flavour, size of the peat...
Quality parameters tested:

- External colour (CIELab coordinates colour space L*, a*, b*), equatorial zone, Minolta CR-300.
- Total Soluble Solids (TSS), digital refractometer ATAGO, results were expressed in °Brix.
- Titratable acidity (TA), Crison Compact Titrator results were expressed as percent malic acid equivalents.
- Total anthocyanins was determined according to the modified method of Ribereau-Gayon and Stonestreet (1965) and expressed as Malvidin Equivalents in mg per 100g of FW.
- Total polyphenols content of the extracts was assessed using the Folin-Ciocalteu phenol reagent method (Singleton and Rossi, 1965) and expressed as Galic Acid Equivalents (GAE) in mg per 100g of fresh weight (FW).
Fruits were collected separated according to different maturity stages based on visual fruit colour.

- “Ripe” corresponds to fruits harvested at the usual stage of maturity for this variety at that region, correspond to bright red colour.
- “Unripe” corresponds to a light red colour
- “Overripe” correspond to dark red colour.

Corresponding to the three first stages (“rojo claro”, “rojo” and “rojo caoba”), on the cherry maturity indices used by the “Pontifica Universidad Católica de Chile”.

All the three ripening stages are significantly different for all the colour coordinates according to Tukey test (p<0.05).

Visual selection done by maturity stage at the orchard was confirmed.
The use of a colour chart should be developed and proposed to farmers.
• Consumers use these two parameters to evaluate sensory quality.
• Less ripe sweet cherries are classified with low values.
Total polyphenols and total anthocyanins. Significant mean differences among the three different ripeness stages for both parameters. Dramatic increase of total anthocyanins observed from ripe fruits to overripe fruits.

Gonçalves (2006) found identical behavior for phenolics indicating always higher in ripe than in partially ripe cherries. Serrano et al. (2004) studied different quality parameters during fruit development and ripening and found that antioxidant activity and phenolic content reached the highest values for the most mature cherries.
CONCLUSIONS

The results obtained in this study, and also in other research works on sweet cherry, and the fact that this is a non climacteric fruit, provide a basis to conclude that:

• There is no economical advantage for producers, neither quality improvement for consumers in picking less ripe cherries.

• Ripe cherries should be better from organoleptic and nutritional point of view, with a strong advantage in higher total polyphenols and total anthocyanins, and a less notable difference in antioxidant activity.

Once again, there is no advantage in picking less ripe cherries for the producers of this region.
2nd Storage of ‘Sunburst’ Cherries Harvested at Different Ripeness Stages

• Effect of different ripeness stages at the moment of harvesting in what concerns the storage ability and the maintenance of quality of ‘Sunburst’ cherries.

• Physical and chemical analyses of quality parameters were made at 0, 4 and 8 days of cold storage with temperature 0ºC and HR 95%.
• **Weight loss** 20 fruits per modality were placed in similar boxes and weighted at day 0, 3, 6 and 9 de conservação. centigramas Mettler Toledo PB 1502.

• **Colour of epiderm** colorímetro Minolta CR-200 iluminant D65, CIELab (coordinates L*a*b*) and C* and h° values. 5 measures per fruit.

• **Detachment peduncle force** Chatillon DFM Digital Force Meter.

• **Texture** texturómetro TA_Hdi da Sh feacicetable Micro Systems, cilíndrical flat stainless probe, with 2 mm of the diameter, until 10 mm of deformation. Twice each fruit, at the equatorial zone on opposite sides. Parameters: **Firmness epidermis (N)**, that corresponds to highest value of force obtained at the rupture point and **Firmness of the pulp (N)**, corresponding to stable force after rupture.

• **Soluble solids content** (TSS), composita sample of 20 fruits, measures by refractometry with a digital refractometer ATAGO modelo PR-101, results were expressed in ºBrix.

• **Titratable acidity** (TA), Crison Compact Titrator results were expressed as percent malic acid equivalents.
**Weight loss**
- Less than 0.35%. (Much less than 4 or 5% for quality depreciation (Oliveira et al. 2000)
- 2 or 3% stem dessication.

**Colour**
- Always different for different maturity stage ($C^*$, $L^*$ e $h^\circ$)
- Maintained colour during storage time.
CONCLUSIONS

• To harvest fruits less ripe seems not to be adequate to storage.

• Cherries less ripe don’t exhibit larger long life than those harvested ripe.

• Cherries harvested less ripe never reach the same quality level of those harvested really ripe, namely organoleptic and nutritional characteristics.

• Considering this storage conditions 0ºC of temperature and 95% of RH, is possible to storage the most ripe cherries during 8 days maintaining quality. This should be important for small farmers that sell cherries in the very same day of harvest.
The sweet cherry ‘Sweetheart’ fruits were harvested at commercial maturation, from an orchard in S. Julião region (Alentejo, Portugal).

Fruits were selected with light mahogany external colour and TSS near 20ºBrix.

Groups of three samples of 30 fruit each were kept in different storage conditions: cold conditions CC (1 ºC, 95% RH); modified atmosphere MA (1 ºC, 95% RH with PPlus bags® (Sidlaw Packaging, Bristol, UK)); controlled atmosphere CA (1 ºC, 95% RH., 10% CO₂ and 8% O₂).

Experimental design was a factorial: Storage Method (CC, MA, and CA) and Storage period (0, 6, 13, 20 and 27 days).

Every sampling day, 90 fruits of each treatment, were randomly picked up and submitted to several analyses; all groups were analysed after fruit temperature stabilised at 20ºC.
PHENOLIC COMPOUNDS

Total Polyphenols values obtained in fruits of CA method were always the lowest.

Total Anthocyanins values of fruits stored under controlled conditions were lower than TA values from fruits stored under MA and cold conditions. All the differences found are not significant (p>0.05).

Total antioxidant activity values also revealed no significant differences (p>0.05) for all the period and all the storage methods, what should be considered an advantage for nutritional proposes. Fruits stored under CA conditions revealed to be the worst for antioxidant activity reaching very low values after 20 days of storage.
PCA allow to conclude that the measures of phenolic compound in general (total antocyanins (TA), total phenolics (TP) and antioxidant activity) are inversely correlated with colour coordinates (L*, a*, b*), and SSC and Titrable Acidity are very close to those measured phenolics compound.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
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<tbody>
<tr>
<td>PT</td>
<td>0.827297</td>
<td>-0.427455</td>
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<tr>
<td>AT</td>
<td>0.743441</td>
<td>-0.392758</td>
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<tr>
<td>Antiox</td>
<td>0.648459</td>
<td>-0.391044</td>
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<tr>
<td>L</td>
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<td>-0.552515</td>
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<tr>
<td>a</td>
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<tr>
<td>b</td>
<td>-0.789133</td>
<td>-0.525164</td>
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<tr>
<td>SSC</td>
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<td>-0.235770</td>
</tr>
<tr>
<td>Acid</td>
<td>0.339269</td>
<td>-0.573918</td>
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</table>
CONCLUSIONS

• ‘Sweetheart’ cherry nutritional quality in what concerns these evaluated phenolic compounds seems to be stable during storage period.

• Phenolic compounds, total antocyanins and antioxidant activity were inversely correlated with values of color coordinates.

• Cherries stored at these CA conditions (1ºC, 95% H.R., 10% CO2 and 8% O2) presented worst values of phenolic compounds, mainly after 13 days of storage.

• Considering all the evaluations done during these work and the goal of distinguish among these storage methods is unquestionable that fruits stored at controlled atmosphere conditions behaved differently.
4th Evolution of Phenolic compounds in ‘Sweetheart’ sweet cherries considering different postharvest conditions

• Factorial experimental design for Storage Method (CC, MAP and CA) and Storage Period (0, 6, 13, 20 and 27 days)
• All analysis were achieved after Shelf-life period simulation at 20 ºC

• Cold Storage Conditions  
  (1ºC, 95% RH)
• MAP Conditions  
  (1ºC, 95%RH, Pplus bags)
• CA Conditions  
  (1ºC, 95% RH 8% O2 y 10% CO2)
Evolution of the several parameters during storage of ‘Sweetheart’ sweet cherries considering different postharvest conditions.
Evolution of the total phenolic contents during the storage of ‘Sweetheart’ sweet cherries considering different postharvest conditions
Evolution of the anthocyanins during the storage of ‘Sweetheart’ sweet cherries considering different postharvest conditions
Conclusions

- MAPs storage conditions, using Pplus films, were the most appropriate conditions to maintain and increase the concentration of these bioactive compounds.

- The amount of the most predominant compounds doubled their concentration in MAPs conditions with regard the amount measured right after harvest at day 0.
Josefa de Óbidos (Sevilha 1630 – Óbidos 1684)