

ACTAS DE HORTICULTURA

XIV CONGRESO NACIONAL DE CIENCIAS HORTÍCOLAS

*Retos de la Nueva
Agricultura
Mediterránea*



Editores:
María Serrano
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PREFACIO

En este volumen de Actas de Horticultura (Nº 71) se recogen las comunicaciones presentadas en el XIV Congreso Nacional de Ciencias Hortícolas celebrado en Orihuela durante los días 3-5 de Junio de 2015.

En total se recogen 134 comunicaciones distribuidas en 15 Sesiones Científicas de acuerdo con el programa científico. Todos los trabajos han sido revisados por pares por parte de los miembros del comité científico y por evaluadores externos.

Los retos de la nueva agricultura mediterránea son conseguir productos de calidad y garantizar un futuro rentable y sostenible para el sector hortofrutícola español, aprovechando las ventajas geográficas y climáticas que han llevado al éxito de nuestra agricultura en los mercados nacionales e internacionales. En este sentido, en las comunicaciones presentadas se reflejan las últimas investigaciones realizadas en España y Portugal sobre diferentes aspectos fisiológicos, genéticos, técnicas agronómicas y de conservación encaminadas a incrementar la producción de frutas y hortalizas, así como sus atributos de calidad y propiedades nutritivas, con especial énfasis en sus propiedades antioxidantes con beneficios para la salud de los consumidores. Para conseguir estos retos es necesario realizar estudios genéticos enfocados a la obtención de variedades mejor adaptadas a las condiciones edafoclimáticas y más resistentes a plagas y enfermedades, estudios fisiológicos para conocer los factores que determinan el crecimiento óptimo de las plantas y desarrollar tecnologías agrarias que permitan obtener altos rendimientos y productos de calidad a precios competitivos. Finalmente, aplicar tecnologías de conservación posrecolección y de industrialización apropiadas para mantener la calidad de los productos vegetales.

Finalmente queremos agradecer el esfuerzo de los autores en la redacción y revisión de los trabajos de acuerdo con las normas de la SECH.

María Serrano
Daniel Valero
Editores

(En Orihuela, su pueblo y el mío, se
me ha muerto como del rayo Ramón Sijé,
con quien tanto quería).

Yo quiero ser llorando el hortelano
de la tierra que ocupas y estercolas,
compañero del alma, tan temprano.

Alimentando lluvias, caracolas
y órganos mí dolor sin instrumento.

a las desalentadas amapolas
daré tu corazón por alimento.

Tanto dolor se agrupa en mí costado,
que por doler me duele hasta el aliento.

.....

Quiero escarbar la tierra con los dientes,
quiero apartar la tierra parte a parte
a dentelladas secas y calientes.

Quiero minar la tierra hasta encontrarte
y besarte la noble calavera

y desamordazarte y regresarte.

Volverás a mí huerto y a mí higuera:

por los altos andamios de las flores

pajareará tu alma colmenera

de angelicales ceras y labores.

Volverás al arrullo de las réjas

de los enamorados labradores.

Alegrarás la sombra de mis cejas,

y tu sangre se irán a cada lado

dísputando tu novia y las abejas.

Tu corazón, ya terciopelo ajado,

llama a un campo de almendras espumosas

mí avariciosa voz de enamorado.

A las aladas almas de las rosas

del almendro de nata te requiero,

que tenemos que hablar de muchas cosas,

compañero del alma, compañero.

10 de enero de 1936

Miguel Hernández

Quality parameters, total phenolic content and antioxidant activity in different maturation stages of 'Sweetheart' cherry

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Keywords: ripening, physico-chemical parameters, fruit quality

Abstract

The cherry fruit is considered a nutrient dense food with a relatively low caloric content and a significant amount of important nutrients and bioactive food components. Nowadays there are some investigations regarding on nutritional and antioxidant properties of cherries. The objective of this study was to determine the stages of maturation of Sweetheart cherry from Cova da Beira (Portugal). Physicochemical parameters: firmness, color (L^* , a^* and b^*), soluble solids content (SSC), pH, titratable acidity (TA), total phenolic content (Folin-Ciocalteu reagent method) and antioxidant activity (DPPH method) of 'Sweetheart' cherry were evaluated. Three maturation stages were identified and results demonstrated that solid soluble content, phenolic compounds and antioxidant activity increase with ripening stages. For soluble solids content and total phenolic content cherries showed the following average values: 19.9, 20.5 and 22.0 ° Brix and 591, 788 and 810 mg galic acid kg^{-1} , respectively.

We can consider that this cultivar has an interest in nutritional terms, which may contribute to the enhancement of 'Sweetheart' cherry from the Cova da Beira region. Additionally, these data provide complementary information which can be used to ensure the quality of this regional product, 'Cereja da Cova da Beira'.

Resumen

La cereza se considera un denso nutriente alimentar con un contenido calórico relativamente bajo y una cantidad significativa de nutrientes importantes y componentes bioactivos de los alimentos. Hoy en día hay algunas investigaciones sobre las propiedades nutricionales y antioxidantes de las cerezas. El objetivo de este estudio fue determinar las etapas de maduración de cereza 'Sweetheart' de Cova da Beira (Portugal). Parámetros físico-químicas: firmeza, color (L^* , a^* b^*), contenido de sólidos solubles (CSS), pH, acidez titulable (AT), contenido de fenoles totales (método reactivo de Folin-Ciocalteu) y la actividad antioxidante (método DPPH) se evaluó en la cereza 'Sweetheart'. Tres etapas de maduración se identificaron y resultados demostraron que el contenido de sólidos solubles, compuestos fenólicos y la actividad antioxidante aumenta con las varias etapas de maduración. Las cerezas mostraron por contenido de sólidos solubles totales y contenido fenólico los siguientes valores medios: 19.9, 20.5 y 22.0 ° Brix y 591, 788 y 810 mg de ácido gálico kg^{-1} , respectivamente.

Podemos considerar que este cultivar tiene un interés en términos nutricionales, lo que puede contribuir a la mejora de la cereza 'Sweetheart' de la región de Cova da Beira. Además, estos datos proporcionan información complementaria que se puede utilizar para garantizar la calidad de este producto regional, 'Cereja da Cova da Beira'.

INTRODUCTION

Portugal produces more than 15 thousand tons of cherries per year and it is in the Beira Interior region where this fruit is more cultivated (Serra et al., 2011). Cherry grown across Gardunha, Estrela and Malcata Saws, (Cova da Beira region) is one of the symbols of this region and is also one of the foundations of its economy. 'Cereja da Cova da Beira' is the legal term used to denominate cherries produced in the Cova da Beira region (PGI) at central eastern part of Portugal, since 1996. The production of this cherry covers a geographic area of approximately 1374 km², which includes the counties of Fundão, Covilhã and Belmonte. The Sweetheart cultivar was introduced recently with an increasing interest. This cultivar is of particular interest due to its late harvest, usually available in late July to the middle of August, and its production is very high and regular.

Nowadays there are some investigations regarding on nutritional and antioxidant properties of cherries (Seeram et al., 2002; Tural and Koca, 2008), however there is little information concerning the changes in quality parameters during ripening processes. The ripeness of the fruit when it is harvested determines its commercial destination and the quality with which it will reach the consumer. It is therefore necessary to have maturity indexes available which indicate the optimum harvesting time so that the fruit maintains the physico-chemical and sensory properties. The aim of this work is to determine different ripening stages of 'Sweetheart' cherry from Cova da Beira (Portugal).

MATERIALS AND METHODS

Cherry Samples

In this study, samples of 'Sweetheart' cherry were supplied by João Verissimo Mendes & filho, Lda. packinghouse. Fruits were harvested on July 2014 in a commercial orchard, located in Cova da Beira (Portugal). The samples were classified according to the color by three ripening stages (red mahogany (Maturation 1-Mat.1), dark mahogany (Maturation 2-Mat.2) and black (Maturation 3-Mat.3). Colour and firmness were measured immediately. The remaining samples were frozen and kept at - 80 °C for determination of total soluble solids, pH and acidity, phenols and total antioxidant activity.

Physicochemical determinations

Colour was determined at the equatorial region of each cherry with a Minolta Chroma Meter CR-400, in the CIELab space, and it was expressed as L*, a* and b*. A white reference plate, a D65 illuminant, a viewing angle of 2 ° and a measurement area of 8 mm were used. Mean values were obtained for 10 cherries per replicate (n=3).

Firmness was measured using a Texture Analyzer TA.XT Plus (Stable Microsystems). Fruits were individually compressed with a flat steel probe to a 5 % deformation, at a rate of 1 mm.s⁻¹. Maximum force (N) was recorded by Exponent 5.1.1.0 software. Mean values were obtained from 10 cherries per replicate (n=3).

Soluble solids content (SSC) and titratable acidity (TA) were assessed in the juice obtained from 10 cherries per replicate (n=3). SSC was determined with an Atago PR32α refractometer. TA was measured by titration with 0.1 N NaOH to a pH of 8.1, with a Titromatic 2S (Crison).

Total phenols were spectrophotometrically determined (Cintra 202 UV Vis Spectrophotometer, GBC Scientific Equipment) using Folin-Ciocalteu reagent, as previously described by Tlili et al. (2011). Total phenols were measured in the juice obtained from 10 cherries per replicate (n=3). Results were expressed as mg of gallic acid kg⁻¹.

Antioxidant activity were spectrophotometrically determined (Cintra 202 UV Vis Spectrophotometer, GBC Scientific Equipment) using 2,2-diphenil-1-picril-hidrazil (DPPH) as described by Brand-Williams et al. (1995) and Sánchez-Moreno et al. (1998). A calibration curve was performed using Trolox, and results were expressed in mg trolox equivalent kg^{-1} .

Statistical analysis

Mean and standard deviation of three replicates were calculated. Data were subjected to analysis of variance and means were separated by Tukey's test at 0.05 significance level (p), using SPSS 19.0 statistical software (IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY, IBM Corp).

RESULTS AND DISCUSSION

The evaluation of maturation stages on 'Sweetheart' cherry quality was based on colour, firmness, soluble solids content, titratable acidity, total phenols, and antioxidant activity. The results are presented in Table 1, Fig. 1 and Fig. 2.

Color directly affects the appearance and the consumer acceptability of the fruits. As can be seen from Table 1, there was variation in lightness (L^*), redness (a^*) and yellowness (b^*), which allowed us to identify three maturation stages. Furthermore significant differences were found in a^* and b^* . The color of the samples differed from red mahogany (Maturation 1-Mat.1), dark mahogany (Maturation 2-Mat.2) and black (Maturation 3-Mat.3). Regarding fruit firmness small variations were found with values between 2.9 to 3.3 N.

Solid soluble content (SSC) varied from 19.9 to 22.0 °Brix (Fig. 1) and increase with ripening stages, while recent studies reported similar values of 20.8 °Brix from the 'Sweetheart' cultivar (Ballistreri et al. (2013)). With respect to values of titratable acidity (TA) and pH similar results were obtained in the three maturation stages (Fig.1) with values of 6.53 to 6.41 mEq. 100 g^{-1} and 4.2, respectively.

Actually producers and consumers are showing an increasing interest in the amount of phenolic compounds, since their role in either promoting health or preventing diseases has been recognized (Kim et al. 2005; Mccune et al. 2011). Phenolic compounds content of 'Sweetheart' cherries ranged from 591 to 810 mg kg^{-1} (Fig. 2). These results are in accordance with the work developed by Usenik et al. (2008) and Ballistreri et al. (2013) which presented similar concentrations of total phenolic content in cherry fruit, with values ranging from 443 to 879 mg GAE kg^{-1} and 850 to 1622 mg GAE kg^{-1} , respectively. The pattern of phenolics modifications seems to be variable among cultivars and ripening stage at harvest (Gonçalves et al., 2004; Serrano et al., 2009).

Antioxidant activity presented a similar behavior as total phenols content, levels of 816 to 1338 mg TE kg^{-1} were found in 'Sweetheart' cherry (Fig. 2). Significant differences were found in total phenolic content and antioxidant activity when comparing three ripening stages.

'Sweetheart' cherry is of particular interest due to its late harvest, and its production is very high and regular. It has been considered essential to cultivate in the end of the cycle. We can consider that this cultivar has an interest in nutritional terms, which may contribute to the enhancement of 'Sweetheart' cherry from the 'Cova da Beira' region. Moreover, these data provide complementary information which can be used to ensure the quality and establish maturation stages which indicate the optimum harvesting time of this regional product, 'Cereja da Cova da Beira'.

ACKNOWLEDGEMENTS

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Table 1- Colour characteristics (L, a and b) and firmness of different maturation stages of ‘Sweetheart’ cherry. Values are expressed as the mean \pm standard deviation.

Maturation stage	L*	a*	b*	Firmness (N)
Mat.1	28,2 \pm 1,6 ^a	20,7 \pm 3,5 ^a	4,7 \pm 1,5 ^a	3,1 \pm 0,5 ^{a,b}
Mat.2	26,8 \pm 0,9 ^b	16,1 \pm 2,5 ^b	2,9 \pm 0,8 ^b	3,3 \pm 0,5 ^a
Mat.3	26,8 \pm 1,3 ^b	11,7 \pm 2,7 ^c	1,9 \pm 0,7 ^c	2,9 \pm 0,5 ^b

Mean values in the same column with different superscripts (a-c) are significantly different ($p < 0.05$) between the different maturation stages of ‘Sweetheart’ cherry

Figures

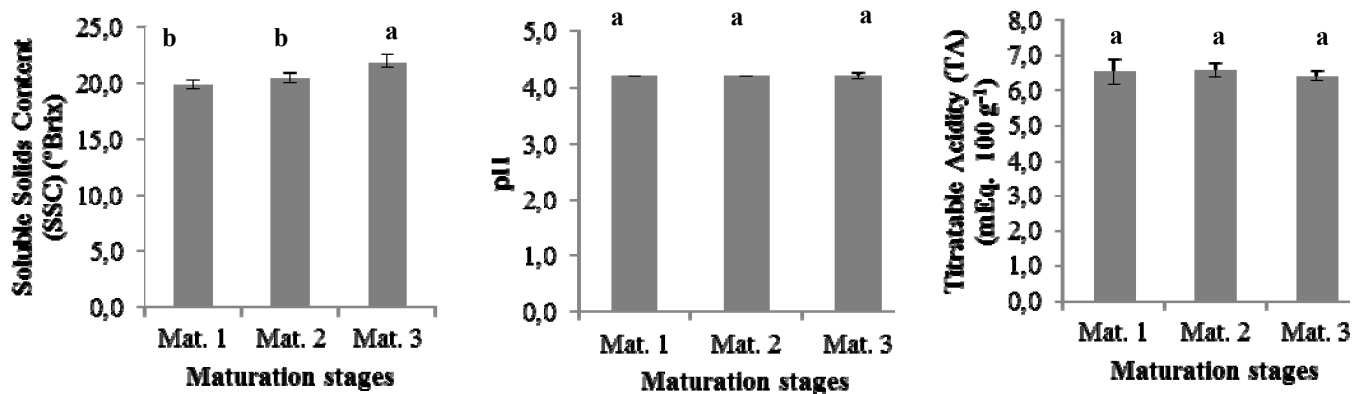


Fig.13 – Soluble solid content (SSC), pH and titratable acidity in three maturation stages (Mat.1, Mat.2 and Mat.3) of ‘Sweetheart’ cherries samples. Values represent mean \pm standard deviation of three independent replicates. Means were compared by Tukey’s test ($p=0.05$).

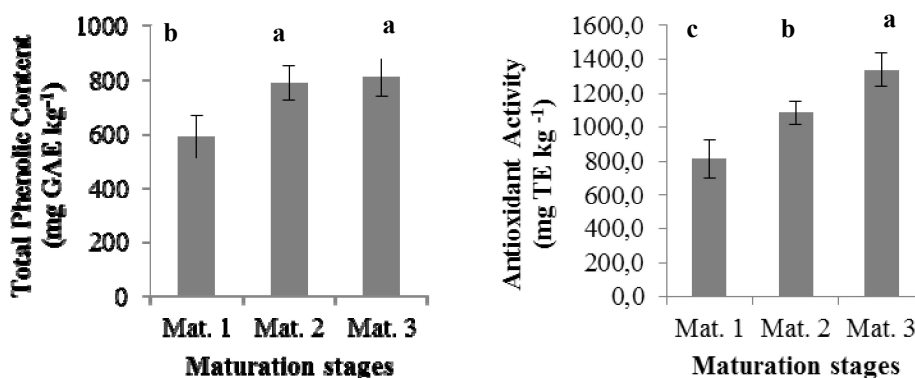


Fig.14 –Total phenolic content (mg GAE kg⁻¹) and antioxidant activity (mg TE kg⁻¹) in three maturation stages (Mat.1, Mat.2 and Mat.3) of ‘Sweetheart’ cherries samples. Values represent mean \pm standard deviation of three independent replicates. Means were compared by Tukey’s test ($p=0.05$).