Seasonal effect on selected quality traits of a melon near-isogenic line

Efecto de la campaña en atributos de calidad seleccionados de una línea casi isogénica de melón

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Abstract

Fruit quality in melon (*Cucumis melo* L.) is an important criterion for consumer's acceptance. Melons development and ripening process are linked to a series of biochemical and physiological changes. This work compared aroma compound classes of a melon near-isogenic line (NIL) SC7-2 during two seasons (S1, S2). The goal of this work was tracking the seasonal influence on the volatiles as potential biomarkers of textural differences (especially flesh firmness) due to introgression in melon LG VII. S2 with a better growing conditions compared with S1 resulted in enhanced quality traits with a slightly lower flesh firmness. Differences between seasons were that the percentage of total acetate esters and other compounds increased in S2, while the percentage of aldehydes, alcohols or alkanes typical of non-climacteric melons diminished. We hypothesize that acetate esters were biosynthesized in non-climacteric melons at a higher extent when growing conditions were favourable.

Keywords: Texture; aroma volatiles; environmental effect.

Resumen

La calidad del fruto de melón (*Cucumis melo* L.) es un criterio importante para la aceptación por parte del consumidor. El desarrollo del fruto y el proceso de maduración están vinculados a una serie de cambios bioquímicos y fisiológicos. Este trabajo compara clases de compuestos químicos del aroma del fruto de melón de una línea casi isogénica (NIL) SC7-2 durante dos campañas (S1, S2). El objetivo de este trabajo fue determinar la influencia de la campaña en el uso de los volátiles como potenciales biomarcadores de diferencias de textura (especialmente firmeza de la pulpa), debido a la introgresión en el melón LG VII. En la campaña S2, con mejores condiciones ambientales para el desarrollo del fruto en comparación con S1, se obtuvo un fruto con mejores atributos de calidad en general y con una firmeza de pulpa ligeramente inferior. Las diferencias entre temporadas fueron que el porcentaje de ésteres de acetato totales y otros compuestos aumentaron en S2, mientras que el porcentaje de aldehídos, alcoholes o alcanos típicos de los melones no climatéricos disminuyó. Nuestra hipótesis es que la biosíntesis de ésteres de acetato aumentó en los melones no climatéricos en mayor medida cuando las condiciones de crecimiento fueron favorables.

Palabras clave: Textura; aromas volátiles; efecto ambiental.

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1. INTRODUCTION

The quality of the melon is composed of features that provide value or degree of excellence for the consumer, being firm flesh texture and good flavor and essential nutritional value. The melon aroma is key in the perception of fruit quality perceived by consumers, and is due to a mixture of compounds of different degree of volatility [1]. The near-isogenic line SC7-2 has been studied previously due to its interest for improving melon flesh firmness associated with cell wall modifications compared with its "Piel de sapo" parental [2].

This work try to elucidate the quality of melons in their postharvest supply chain as part of our breeding strategies to improve the crop overall quality. Particularly, will gain knowledge based on near-isogenic lines (NILs) of melons and the genetic map of melon [1], a model system where many quantitative trait loci have been identified useful for postharvest purposes, with emphasis on multidisciplinary studies involving quality traits, physiological and biochemical studies, and modelling.

2. MATERIALS AND METHODS

The melon near-isogenic line (*Cucumis melo* L.) SC7-2 was obtained through interbreeding led by molecular markers between a Korean variety "Songwhan Charmi" PI 161375 (SC) and the Spanish cultivar type T111 "Piel de Sapo"(PS) [1]. Melon cultivation was under Mediterranean conditions in Torre Pacheco (Murcia, Spain). According to the Information System of Murcia (SIAM) the average temperature and precipitation from April to July, were 71,30mm/21,19°C for Season 1 and 24,60mm/21,04°C for Season 2 [6]. The plot design was randomized and the number of replicates was 7 for the NIL, collecting a minimum of 2 fruits per replicate. The physiological behavior is determined and the pulp firmness was measured with a 4.6 mm diameter punch with a testing machine. For the analysis of volatile juice pulp mixed with a saturated calcium chloride solution fruit, (the mixture containing 71.5% of filtered juice) and subsequently analyzed in a gas chromatograph equipped with a mass spectrometer under the method of solid phase microextraction headspace [1]. The chromatograms integration, the individual compounds analysis, the separation of aroma groups by chemical compounds, and quantification of results by percent of total area counts, were conducted. A one-way ANOVA analysis of the quality traits using season as factor and separating means by a Tukey test (P=0.05) was performed using 5.1 software (SAS Institute Inc., Cary, NC).

3. RESULTS AND DISCUSSION

The S1 did not reach the optimum quality for melon due to raining and sub-optimum temperatures during the growing season compared with S2. This is in part in agreement with differences in quality traits of the melon near-isogenic line SC7-2 in S2 compared with S1, particularly higher levels of soluble solids, juice yield, dry matter and slightly lower firmness (Table 1).

After calculating and comparing the mean percentage of each compound class depending on the season (Table 1) aldehydes followed by alcohols were predominant. Unidentified compounds and compounds typical of the fiber or column bleeding were not considered for Table 1 but did not shown significant differences between seasons. In S2 significant higher levels of acetate esters and other compounds were found concomitant with lower levels of alcohols, alkanes, etc. (Tables 2) The induction of higher levels of acetate esters are typical differences among climacteric versus non-climacteric cultivars of melons [3], but we found here some evidences of potential induction of the biosynthesis of certain acetate esters at high levels also in

non-climacteric types. Among these types of esters ethyl acetate; isopropyl acetate; 1-Butanol, 3-methyl-, acetate, and n-propyl acetate, in agreement with results in climacteric NILs [3]. Also other esters were important in season 2 from other types such as sulfur derived esters (methyl thiolacetate; methyl 2-(methylthio)), also important in climacteric NILs [3].

Fruits with climacteric behaviour have a short shelf-life and higher aroma levels than non-climacteric fruits, because some aroma compounds are produced almost exclusively by ethylene-dependent pathway. In climateric genotypes, the volatiles reported are mostly esters and sulfur-derived ester compounds [5], and here we found also these types particularly in the second season (Table 2). On the other hand, the melon non-climateric near-isogenic line SC7-2 show an important aroma level. So, we can develop a good melon variety in terms of quality, shelf-life and aroma.

The fruit melon quality can be affected by many factors, and the seasonal effect is mostly associated with environmental effects but also cultivar x environment effect, for example at the nutritional level. In fact the insufficient or excessive potassium level adversely affects fruit quality, while adequate K nutrition is associated with increased yields, fruit size, increased soluble solids and ascorbic acid concentrations, improved fruit color, increased shelf life, and shipping quality of many horticultural crops [4]. SC7-2 has been reported also having some problems of cracking [5], probably due to firm texture and therefore some limits to get the best potential texture and flavor should be studied in the future for non-climacteric melons with enhanced texture.

4. CONCLUSIONS

A better growing season in the melon near-isogenic line SC7-2 enhanced most of the quality traits analyzed but modified the proportion of compound classes. We hypothesize that acetate esters were enhanced in seasons with better growing conditions for melons even in non-climacteric types.

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Tables

Table 1. Fruit quality traits (means ± SE, n=7) of the melon near-isogenic line SC7-2. Means followed by different letter within rows were significantly different between seasons according with a Tukey test (P=0.05).

Quality trait	Season 1			Season 2		
Soluble Solids (°Brix)	9.2	±0.1	a	12.0	±0.1	b
Flesh firmness (N)	11.5	±0.2	a	9.3	±0.1	a
Juice yield (% W/W)	17.7	±0.8	a	32.7	±0.2	b
Dry matter (% w/w)	10.1	±0.1	a	12.9	±0.1	b
Juice density (kg/ m^3)	1019.0	±1	a	1023.0	±2	a

Table 2. Selected aroma volatile group of compounds by season (mean of total area counts ± SE, n=7) of juice obtained from fruit of the near-isogenic line of melon SC7-2. Means followed by different letter within rows were significantly different between seasons according with a Tukey test (P=0.05).

Quality trait	Season 1		Season 2	
Acetate ester	4.0	±1.0 a	17.6	±3.4 b
Non-acetate ester	3.3	± 0.6 a	2.0	± 0.6 a
Aldehydes	27.2	±4.0 a	20.1	±3.3 a
Alcohols	10.6	±2.9 a	6.9	±1.1 b
Ketones	6.1	±1.4 a	3.9	±0.7 a
Acids	0.4	±0.1 a	0.0	±0.0 b
Sulfur derived compounds	4.5	±1.3 a	1.8	±0.9 a
Terpenes	0.1	±0.1 a	0.0	±0.0 a
Alkanes. Hydrocarbon Aliphatic	1.6	±0.2 a	0.6	±0.1 b
Others	1.6	±0.2 a	13.1	±2.2 b