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Effects of packing line operations on some quality attributes of persimmon fruit cv. 'Rojo Brillante'

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SUMMARY – The quality of 'Rojo Brillante' persimmon fruits was evaluated after post-harvest operations in a packing-line machine. After astringency removing treatment, and storage for five days at 1°C and three days at 15°C no significant changes in firmness were detected. An increase in fruits hit number was found when fruits were manipulated in the packing-line machine. To complete the evaluations, impact tests were conducted with an IS100 (Instrumental Sphere). High impact occurred at the drying machine exit, falling into the calibration machine and in the fruit expulsion. The highest impact percentages (intensity 50-100 *g´*s) were detected in the drying machine and falling into the calibration machine. There was a tendency to increase the accumulated impact percentage with intensities from 50 *g´*s to 100 *g´*s, and less than 50 *g´*s.

Key words: Packing-line machine, persimmon fruits, hit, impact.

RESUME – *"Effets des opérations de la chaîne de conditionnement sur quelques attributs de qualité du fruit du plaqueminier cv. 'Rojo Brillante'". La qualité des fruits de kaki cv. 'Rojo Brillante' a été évaluée depuis les opérations post-récolte à la ligne de conditionnement. Après un traitement d'élimination de l'astringence et le stockage pendant 5 jours à 1°C et 3 jours à 15°C pas de changements, significatifs de la fermeté n'ont été détectés. On a trouvé une augmentation du nombre de coups quand les fruits sont passés par la ligne de conditionnement. Pour compléter les évaluations, les impacts ont été déterminés avec un IS100 (Instrumental Sphere). L'impact majeur a été à la sortie du sécheur, à la tombée au calibreur et à l'expulsion des fruits. Les pourcentages majeurs d'impact (intensité 50-100* g´*s) ont été détectés entre le sécheur et la tombée au calibreur. Il y a eu une tendance à augmenter le pourcentage d'impacts accumulés avec des intensités de 50 à 100* g´*s et moindres de 50* g´*s.*

Mots-clés : *Ligne de conditionnement, kaki, coup, impact.*

Introduction

'Rojo Brillante' is an astringent persimmon cultivar, very important in the region of Ribera del Xuquer, Valencia (Spain). The main characteristics of the fruit commercialised as *Persimmon*, are their greater firmness and size (Escutia, 2000), and the possibility to remove astringency with the help of anaerobic atmospheres. Nowadays, in Valencia, carbon dioxide atmospheres are used because of their high efficiency (Arnal and del Río, 2000).

However, these fruits are susceptible to damage when they are picked and/or manipulated on packing-line machines. This damage is generally due to hits of some fruits either on other fruits or on surfaces. These hits become a dark spot and therefore the commercial value of fruit is reduced. Currently, this problem has become greater since the damaged fruits do not have commercial use.

The use of electronic sensors has allowed us to evaluate post-harvest processes and find the dangerous points. In these points, the fruits are exposed to impacts, compressions, and other situations of mechanical stress. These studies could make it possible to propose improvements in the packing line machine (Salvadores *et al.*, 2001)

To determine the mechanical impacts that produce damage to fruits, we studied the effects of a packing-line machine on an IS100 sensor and on persimmon fruits, cultivar 'Rojo Brillante', whose astringency had previously been removed.

Material and methods

Persimmon fruits of 'Rojo Brillante' were picked on 2 December, 2000 at L'Alcudia (Valencia) Spain.

The electronic sensor IS100 (Instrumented Sphere), is a sphere made of epoxy resin, weighing 312 g and measuring 89 mm in diameter. It looks like the fresh fruit and it has a triaxial accelerometer which is able to register the higher acceleration in gravity units (1 *g´*s = 9.8 m/s^2) and the time of impact in milliseconds for each impact (Hernandez, 2000).

The packing-line machine in the Cooperativa Nuestra Señora del Oreto (L'Alcudia) has transporting rollers in most of the zones, although in other zones (end of selection to calibration in and packing after expulsion) it has flat belts. At the beginning, the packing-line machine has a bath that alleviates the hits of the fruits at the entrance. The fruits are then dried in an air drying machine at 18°C, and afterwards they go to the selection area where trained people exclude the damaged fruits from the harvest. Next, the fruits are calibrated according to their size by a photograph calibrator and finally they are packed.

Methodology

Removing astringency was carried out by keeping the fruits under carbon dioxide atmosphere (90% CO_2) for 36 h at 8°C.

Tests with electronic sensor IS100: the IS100 sensor was mixed in with the fruits seven times, from the beginning to the ending of the packing-line machine. The time when the IS100 reached various points of transference (i.e. drying in, drying exit, end of selection, calibration and expulsion) was recorded in order to know the impact values registered in the sensor at these points.

Tests on persimmon fruit cv. 'Rojo Brillante': samples of 30 fruits each were taken: before the packing-line entrance, drying in, drying exit, end of selection and expulsion. The fruits were kept for five days at 1°C, 85-90% RH and subsequently for three days at 15°C, 85-90% RH. The firmness was evaluated with a texturometer Instron Universal Machine model 4301 (plunger 8 mm), and expressed as load (kg) to break the fresh fruit in the equatorial zone. The hits were evaluated visually and were expressed as the number of hits per fruit.

The results were evaluated with Anova and multiple comparison between means with the LSD test ($p \leq 0.05$), (Program Statistic Statgraphics Plus 2.1).

Results and discussion

Assays with electronic sensor IS100

The highest impact was detected at these: drying exit, calibration in and expulsion. However, if we consider the threshold of impact near values of 50 *g´*s, i.e. value that represents the threshold of damage for some temperate fruits (Hernandez, 2000), the most relevant impact was the one found at expulsion (Fig. 1). Other authors reported in 'Lanelate' oranges the existence of a high number of impacts at the expulsion point after fruit calibration (del Río *et al.*, 2000).

The highest percentage of marked impacts (50-100 *g´*s) was detected from the drying exit through calibration machine (Fig. 2A). The percentage of impacts (50-100 *g´*s) from calibration through expulsion was lower than in the other zones, however their intensities were the highest (Fig. 1). There was a tendency to increase the percentage of accumulated impacts with intensities ranging from 50 to 100 *g´*s, and less than 50 *g´*s (Fig. 2B).

Assays on persimmon fruits cv. 'Rojo Brillante'

No significant differences were found in firmness of either manipulated or not manipulated fruits. However, there was a tendency in its reduction from 1.15 kg at the entrance to 0.88 kg at the expulsion.

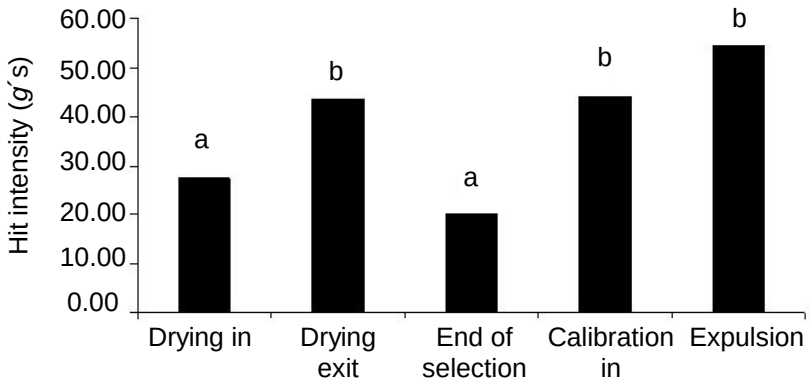

Fig. 1. Hit intensity (*g´s*) registered at each point of transfer detected according to the times when the electronic sensor IS100 passed each point. the values with the same letter are not different by more than 5% according to the LSD test. The values with the same letter are not different by more than 5% according to the LSD test.

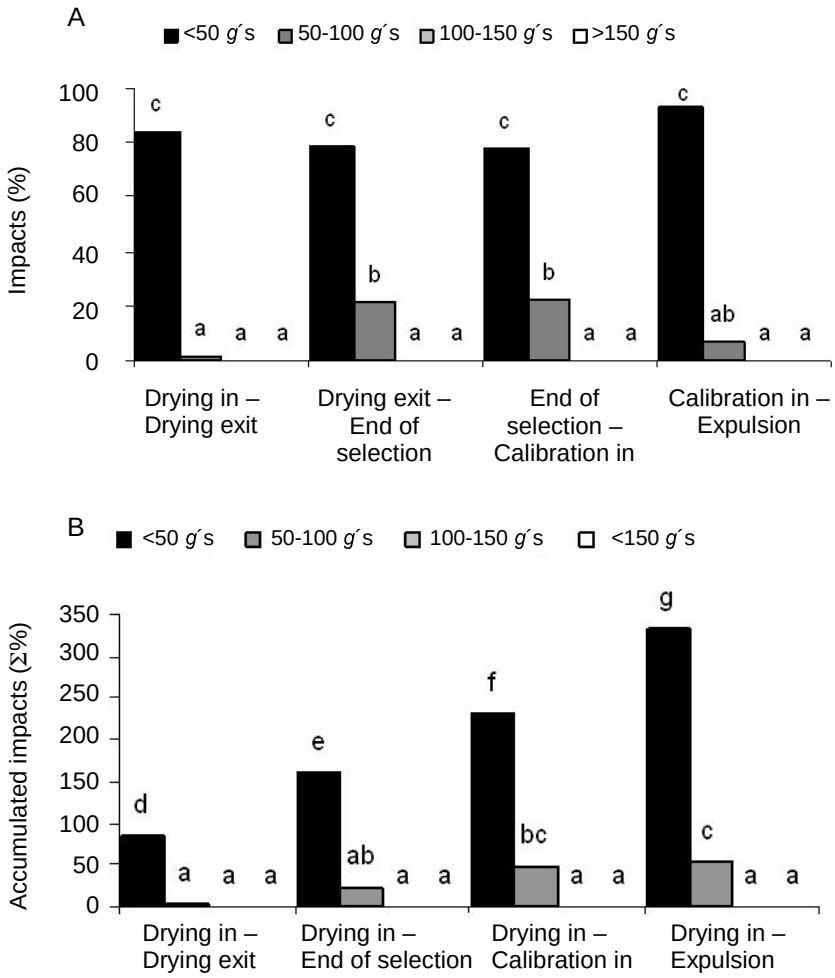

Fig. 2. (A) Percentage of impacts in the evaluated zones, according to their intensity (*g´s*). Each zone includes the impacts of the point which ends it. (B) Percentage of accumulated impacts (Σ%) from the drying in to each transfer point, according to their intensity. The values with the same letter are not different by more than 5% according to the LSD test.

An increase of hits/fruit when the fruits were passed through the packing-line machine was detected (Fig. 3A), and it could be related to an increase of accumulated impacts. Perhaps there is a linear relation between the percentage of accumulated impacts registered on the IS100 sensor, and the hits/fruit which we detected from the entrance to the following points: (1) drying exit; (2) end of selection; and (3) expulsion. However, this only occurs for the intensity ranging from 50 to 100 *g´s*, and less than 50 *g´s*; this tendency needs to be verified with other studies including a greater number of points. There was a high accumulation of impacts of less intensities, in the same hits/fruits (Fig. 3B). A linear relationship between the impact energy (J) and the surface of the hit on the fruit was observed by other authors in orange fruits (Ortiz *et al.*, 2001).

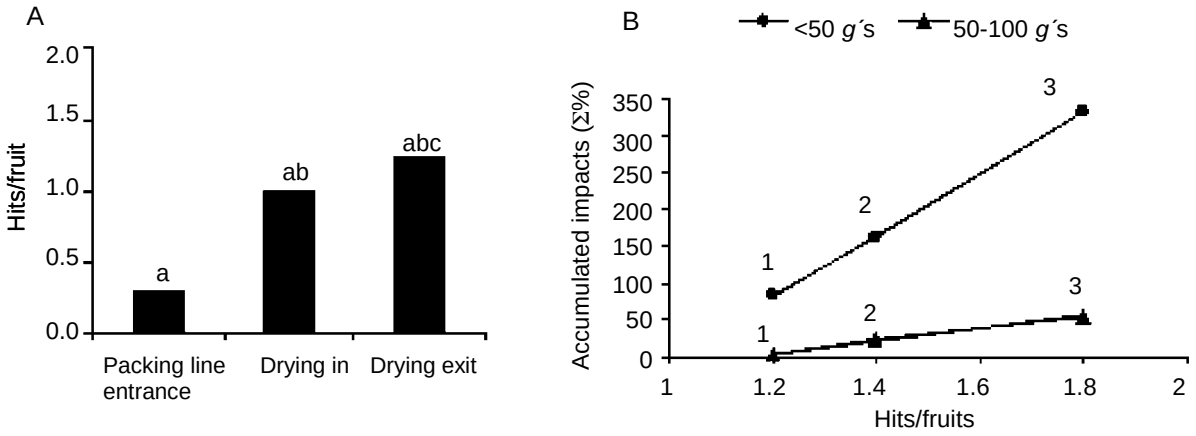

Fig. 3. (A) Hit number average detected on each fruit sampled in each point of the packing-line machine, and kept five days at 1°C plus three days at 15°C. (B) Relationship between the percentage of accumulated impacts registered by the electronic sensor and the number of hits per fruit detected from the packing line entrance to the following points: (1) drying exit; (2) end of selection; and (3) expulsion, for the intensities (*g´s*) when this relationship did exist. The values with the same letter are not different by more than 5% according to the LSD test.

Conclusions

The highest intensity of punctual impacts was detected in the drying exit, calibration in and expulsion. The highest percentage of impacts (50-100 *g´s*) was detected from the drying exit towards calibration machine. There was a tendency to increase the percentage of accumulated impacts for intensities ranging from 50-100 *g´s* and less than 50 *g´s*. This was in agreement with an increase in the hits/fruit when fruit passed through the packing line. No significant changes in firmness were detected, however there was a tendency toward its reduction.

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