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Puncture test as an additional qualifying index of control on pineapple, mango and cassava.

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Abstract

Mango and pineapple fruits together with cassava roots were subjected to different post-harvesting processing in order to increase their shelf life. Mechanically driven instrument (Lloyd machine), hand operated penetrometer and sensory analyses were used to study the changes produced on the three samples along the storage, establishing correlations with qualifying indexes. Results of firmness of mango fruits obtained by using a Lloyd have a poor correlation with °Brix and a good one with hand operated penetrometer (r^2 = 0.97). No correlation was found between puncture results of firmness obtained by a Lloyd machine with either the internal colour or firmness of sensory analyses of mango. Instrumental measurements could be used as an additional tool to control maturity for mango fruits. No correlation was found between firmness obtained by a Lloyd machine, with quality parameters or maturity indexes obtained by sensory evaluation of pineapple. A good correlation was found between firmness and fibrosity determined by sensory evaluation with firmness determined by a Lloyd machine for different cassava genotypes (r^2 = 0.9). No correlation was found between the firmness obtained by a Lloyd and firmness determined by sensory analyses when one cassava genotype was used. No correlation was found between a hand operated penetrometer and a Lloyd on pineapple and cassava.

Keywords. puncture test, firmness, mango, pineapple, cassava, maturity index

Resumen

Frutas como mango y piña conjuntamente con raíces de yuca fueron sometidas a diferentes tratamientos pos cosecha con el objeto de incrementar su tiempo de vida. Instrumentos de análisis de textura como la máquina Lloyd y penetrómetros manuales conjuntamente con análisis sensorial se emplearon para estudiar los cambios producidos en los tres materiales durante su almacenamiento y establecer al mismo tiempo correlaciones con índices de madurez. Resultados de la firmeza de mango obtenidos mediante una máquina Lloyd tuvieron pobre correlación con °Brix y una buena correlación con penetrómetros manuales (r^2 = 0.97). No se encontró correlación entre los valores de firmeza obtenidos con análisis de penetración en una máquina Lloyd con el color interno del mango ni tampoco con la firmeza obtenida por análisis sensorial de la fruta. Los análisis instrumentales pueden ser utilizados como una herramienta adicional para el control de madurez en mango. No se encontró correlación entre la firmeza obtenida por una máquina Lloyd con índices de madurez obtenidos por evaluación sensorial en piña. Una buena correlación fue obtenida entre la firmeza y la fibrosidad obtenidas sensorialmente con la firmeza determinada por una máquina Lloyd para diferentes genotipos de yuca (r^2 = 0.9). No se obtuvo correlación entre la firmeza obtenida por una máquina Lloyd y la firmeza determinada sensorialmente cuando un solo genotipo de yuca fue analizado. No se encontró correlación entre los resultados obtenidos por el penetrómetro manual y la máquina Lloyd en piña y en yuca.

Palabras Clave. Análisis de penetración, firmeza, mango, piña, yuca, índices de madurez

Introduction

The world economy has grown as a result of and international trade between Asia, Africa, Europe and Latin America. As a result of this change, Latin America has shown an increased in the production of agricultural products as flowers, fruits and vegetables (fresh and pro-

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cessed).

The losses of agricultural products due to the lack or absence of post harvesting techniques are between 15 to 50% in developing countries, whereas they are between 5 and 25% in developed countries, where post harvesting techniques have been used. However of the obvious advantage of using such techniques, these are not widely used in developing countries. Ecuador is not an exception and the production of mango and pineapple among others requires technological processes to avoid losses after harvesting.

Textural measurements performed by hand or by sensory evaluation have been used widely to evaluate the quality of fruits. Additional parameters to evaluate the maturity of fruits are brix, acidity and colour. Puncture tests are a useful index of quality and maturity on pears, peaches and strawberry fruits [1, 2, 3].

The present paper presents a study of the possible correlation between firmness obtained by puncture test of both hand and mechanically driven instruments with maturity indexes and sensory parameters of mango, pineapple and cassava subjected to different post-harvesting techniques and storing temperatures.

Methods and Materials

Materials

Mango

Mangoes of the varieties Tommy Atkins and Haden from Puná Island, Ecuador were used for the study. Mangoes of two maturity indexes, minimal physiological maturity and maximum physiological maturity, were used. The mangoes were subjected to the following post-harvesting treatments:

- Hydro thermal treatments.
- Covering by using plastic films: low density polyethylene, width 15 and 30 μm; and Criovac D-995
- Covering with Britex wax
- Bath in calcium solution

After the post-harvesting treatment was given, the fruits were stored at refrigeration conditions for different times, followed by storage at 25^{o}C for 5 days.

Pineapple

Pineapple fruits, variety Cayena Champaca from Santo Domingo de los Colorados, Ecuador were used during the study. The fruits were transported and subjected to the following treatments:

- Pre cooling by using air flow at 2^o and 10^{o}C, and normal cooling at 8^{o}C
- Covering by using 5% Tandem wax; adding a fungicide, 0.5% Bayleton.
- Covering by using plastic films: low-density polyethylene, with either 4 or 200 holes.

After the post-harvesting treatment was given the pineapples were stored at refrigeration conditions for different times, followed by storage at 20^{o}C for 7 days.

Cassava

The following four cassava genotypes were used: MCOL 1468, SG 107-35, and CM 2177-2, identified by CIAT, Cali, Colombia (Centro Internacional de Agricultura Tro pical), and the Escansela genotype (criolla) from the Ecuadorian market.

Cassava samples with good morphological characteristics and less susceptibility to physiological damage were covered with wax at 120^{o}C and stored at 8^{o}C and 92% moisture.

Methods

The soluble solids content (^{o} Brix) was performed at 20 ^{o}C by using an ABBE refractometer. Translucidity and colour of mangoes was done according to [4].

Firmness studies were performed by using puncture tests with a Lloyd machine and a hand operated penetrometer. Puncture tests were done at duplicate on each sample. Mango samples were obtained from the sides of a peeled fruit. When pineapple was analysed, the central part of the fruit was used. In all the cases removing of the skin was done before the puncturing test was performed [5]. Taking into account one treatment only, two samples for each day of storage were used for the study, for both mango and pineapple. Firmness studies of cassava samples were performed by using a Lloyd machine with a compression-extrusion (Kramer cell). Analyses were done in duplicate for each cassava variety. Cassava samples were peeled by hand and boiled before the analyses of firmness were performed. Cassava samples were obtained from the central part of a cassava root. For each sample, half of the sample was used for the sensory analyses and the other half for the instrumental analyses.

Hand operated penetrometer together with a Lloyd machine were used on the analyses. Hand operated penetrometer, 5 and 15-kgf scale, McCormick, with a dial, a spring and round tips of 6 and 8 mm diameter for mango and pineapple, respectively.

A Lloyd machine (Lloyd Instruments Ltd., Hampshire, United Kingdom) together with round tips of 6 and 8 mm diameter, was used for analyses of mango and pineapple respectively. A depth of penetration of 30 mm and speed of travel 20 mm/min were used for mango and pineapple. The yield point was used to evaluate the firmness on both fruits. A Kramer cell operated at a speed of 10mm/min was used for the analyses of cooked

cassava, and the yield point was used to evaluate the firmness of the sample. The average of two fracturability measurements was used for further analyses.

A group of 8 semi-trained persons performed the sensory analyses. The firmness of fruits and cassava samples was determined using a lineal scale. The firmness was evaluated as the necessary force to cut the sample with the teeth. Fibrosity of cassava was evaluated as the presence of fibres on the cooked samples.

Results were analysed by using STATGRAPH software in order to obtain the correlations between the parameters.

Results and Discussion

Mango

Results of firmness obtained by using a Lloyd machine with those obtained with a hand operated penetrometer had a high correlation, $r^2 = 0.97$. A poor correlation was found between measurements obtained with a Lloyd machine and brix and with internal colour, with r^2 of 0.75 and 0.42, respectively (Table 1).

	Correlation between	r^2
Mango	Lloyd - penetrometer	0.97
	Lloyd - internal colour	0.42
	Lloyd - Brix	0.75
Pineapple	Lloyd - penetrometer	0.60
	Lloyd - sensory	0.02
	Lloyd - translucidity	0.25

Table 1: Correlation between firmness determined by a Lloyd machine with hand operated penetrometer and maturity indexes of mango and pineapple

No correlation was found between puncture results of firmness obtained from a Lloyd machine with the internal colour or firmness of sensory analyses (Table 1).

Measurements of firmness determined by either hand operated penetrometer or mechanically driven instruments (Lloyd machine) could be used as an additional index of maturity for mango fruits.

Pineapple

No correlation was found between firmness obtained from a Lloyd machine with firmness obtained by sensory evaluation, with firmness of a hand operated penetrometer or with translucidity (Table 1).

Instrumental measurements are not a good index to evaluate the maturity of pineapple. The lack of correlation could be due to the variability among the small fruits contained on each pineapple (Table 1).

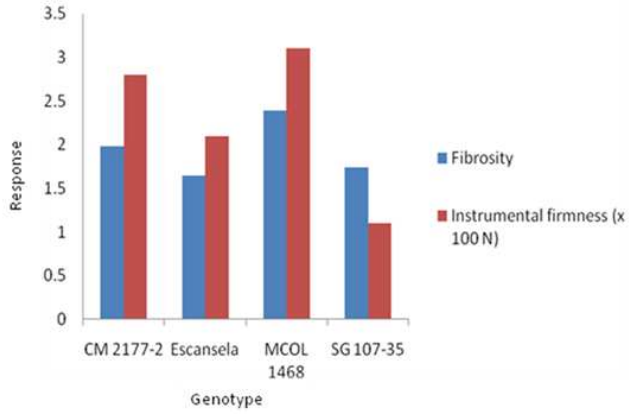

Figure 1: Firmness determined by a Lloyd machine and fibrosity determined by sensory analyses of four cassava genotypes

Cassava

The figure 1 shows the results of firmness and fibrosity of four cassava genotypes obtained by a Lloyd machine and sensory analyses, respectively. A good correlation was found between firmness and fibrosity with regression coefficients of 0.9. The Ecuadorian variety has the lowest firmness and fibrosity among the four genotypes.

Conclusions

Firmness determined by using a Lloyd machine could be used as an additional tool to control maturity of mango fruits and cassava roots. However the maturity control of cassava is valid only when different cassava genotypes are used.

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