EVALUAREA CALITĂTII CAISELOR PRIN METODE NEDISTRUCTIVE. QUALITY EVALUATION OF APRICOT FRUIT BY NONDESTRUCTIVE TECHNIQUES

Cristina Petrisor¹, Gabriel Lucian Radu², Adela Barbulescu¹, Maria Dumitru¹, Gheorghe Campeanu³
¹Research Station for Fruit Growing Baneasa
²University – Polytechnic of Bucharest
³University of Agricultural Sciences and Veterinary Medicine Bucharest

Abstract

Quality of ripened apricot depends on its maturity at harvest which was determined in the past subjectively and based on visual ratings. We have explored in this paper the feasibility of two novel nondestructive techniques for rapid quality measurement of apricot and determination of optimal harvest date: acoustic impulse response technique for firmness and reflectance spectroscopy for fruit color. The color parameters L*, a*, b* of freshly harvested apricots ranging from immature to over mature were measured using HunterLab Mini Scan XE Plus spectrophotometer. Among colour parameters CIEXYZ, a* and hº value are feasible indicators for distinguish different maturity stage of apricot. Acoustic response measurements using an AWETA Acoustic Firmness Sensor gave a reliable indication of the change in mechanical properties of fruit during maturation. Our results suggested that acoustic firmness index could be used for distinguish between different maturity stage of apricot fruit.

Cuvinte cheie: parametri de culoare, fermitate acustica, caise, calitatea fructelor,
Keywords: color parameters, acoustic firmness, apricot, fruit quality

1. Introduction

Quality control analysis have become of fundamental importance in the last few years to ensure the supply of high quality fruits and have underscored how important it is a harvest fruit at the proper degree of maturation. Some quality parameters like soluble solids, titratable acidity, carotenoid pigments, color, dry matter, firmness, pectic substances have been used to determine maturity and quality of apricot. But many of them were determinated with laborious destructive techniques.

Nowadays, nondestructive techniques for quality evaluation have gained in popularity. Color and firmness of fruits as components of quality are important to the growers and to processors as they affects product appearance and consumer acceptance (Gomez & al., 2005; Luchsinger and Walsh, 1998).

Application of acoustic impulse response method are reported for evaluation of apple, kiwi, mango, peach texture but not on apricot (Abbott & al., 1997; Gomez & al., 2005; Muramatsu & al., 1996).

It is a little information about background color modification of apricot fruits during maturation on tree( Kovacs & al., 2008; Ledbetter & al., 1996; Petrisor & al., 2006; Ruiz & al., 2005).

The objective of this study were thus to define a maturity and quality index for two apricot cultivar (’Excelsior’ and ‘Nicusor’), through exploring the potential of acoustic impulse response method and by measuring color parameters.

2. Materials and Methods

Two medium ripening apricot cultivars (’Excelsior’ and ’Nicusor’) from Research and Development Station for Fruit Growing Baneasa orchard were evaluated during two seasons.

Objective color measurements were assessed using a HunterLab Mini Scan XE Plus spectrophotometer. In the Hunter scale, L measure lightness and varies from 100 for perfect white to zero for black approximately as the eye would evaluate it. The chromaticity dimensions “a” measures redness when positive, gray when zero and greenness when negative, and “b” measures yellowness when positive, gray when zero, and blueness when negative.

The setup of the colorimeter was changed to color scale and the cone was kept in complete contact with the apricot surface to prevent leakage of light emitted by device.

The color values of freshly harvested apricot was performed on samples containing 15-20 fruits for every cultivar, each fruit being analyzed upon two side (the more colourful and the lesser color side ) in the equatorial zone of fruit. Each fruit was measured twice on each side, for establishing the average of color parameters.

Acoustic firmness was measured at the equator of the unpeeled fruit in two repetitions using an AWETA Acoustic Firmness Sensor. In this device, an acoustic signal is generated by means of gentle impact on the equator of the fruit. This signal is processed and transformed to obtain a peak of natural frequency, which is used to calculate the stiffness factor as f² x m²/³, where f represents this frequency and m is the fruit mass.
The determination of dry matter was realized through dried of sample at a temperature of 105°C until they reach constant weight. The measurement of dry weight was performed on three fruits with two replicates. The results were expressed as percent of fresh weight.

Carotene content was determinate from pulp and peel by measuring the absorbance of samples with UV-VIS spectrophotometer using the method of (Rodríguez-Amaya, 2001)

3. Results and discussions

From acoustic measurement we observed changes in resonant frequency during maturation period of apricot because tissue softening. Acoustic firmness index, decrease during fruit maturation to value 3 at ripe stage. Both cultivars have fruits with high firmness at this stage what show compact and high density fruit (table 1).

Dry matter increases during the ripening of the apricot. Dry matter gain is more important during the last two maturity stage and the less significant beyond first maturity stage (tab.1). As it can be seen in table 1 the total carotenoids content increase and varied from 0.7 to 4.79 mg/100g f.w for Excelsior cultivar and from 0.8 to 3.78 mg/100g f.w during maturation of fruit.

Color parameters L* and b* varies different so values increase in first two maturity stage and then decrease so that fruit have a dark orange color (fig.1, fig.2).

Chromatic parameter a* increased during maturation from negative value (green stage) to positive value (ripe stage) fruit, having a less pronounced degree of red.

Hue of fruit represented through hue angle (h°) decreased from value between 96-99 that corresponding green light color to 50-60 for ripe stage what evidence a orange - yellow light color (fig.1,fig.2).

We observed from spectras shape that in green stage a peak at 550 nm for both cultivars. In half - ripe stage, we observed two absorbance maxims at 610nm and 640nm and a minimum at 680 nm. The ripe and over ripe fruits spectra’s present a maximum at 650 nm and a minimum at 680 nm (fig.3, fig.4).

The lower values of reflectance (30-50%) are related to higher chlorophyll content. Corresponding to the decrease in chlorophyll content, the reflectance between 580-700 nm increases (60-70%) as a result of the ripening process. With advancing maturity grade, the spectral reflectance curves flatten.

Among color characteristics CIELAB, h° and a* values showed the visible modification during maturation of both cultivars studied and they are feasible indicators for distinguished different maturity stage. Therefore background color of fruit is the first indicator to establish the most appropriate moment for harvest.

However fruit color, can be different from year to year depending on climatically conditions (lightness and temperature).

Using optical spectral criterions, allow a precise monitoring of fruit development and of optimum harvest time. Thus spectral measurements have a promising potential for added that fruit quality indices besides a* and h° color parameters.

We analyzed the correlation between parameter L*, a*, b*, C*, h°, and carotenoid pigments for both cultivars . We obtained significant correlation between a* and h° parameters and carotenoid content (R²> 0.80). For others color parameters L*, b*, C*, we obtained satisfactory correlation (R²=0.6) for ‘Nicusor’ cultivar and good correlation (R²> 0.80) for ‘Excelsior’ cultivar.

From regression curves for acoustic firmness and dry matter we obtained that the correlation coefficients R² have high value.

It was established that the quality indicators as colour parameters and acoustic firmness index are useful to decide fruit maturity stage and the appropriate harvest time.

So, it is beneficial to combine different tests for non-destructive quality assessment of fruit.

References

Tables and Figures

Table 1. Variation of physico-chemical attributes of apricot

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Maturity stage</th>
<th>Acoustic Firmness Index (Pa)</th>
<th>Dry matter g%</th>
<th>Carotenoids mg/100f.w</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excelsior</td>
<td>Green mature</td>
<td>14.8</td>
<td>9.35</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Half ripe</td>
<td>8.7</td>
<td>13.9</td>
<td>1.73</td>
</tr>
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<td></td>
<td>Ripe</td>
<td>3.5</td>
<td>20.92</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>Over ripe</td>
<td>3.4</td>
<td>21</td>
<td>4.79</td>
</tr>
<tr>
<td>Nicusor</td>
<td>Green mature</td>
<td>13.6</td>
<td>12.29</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>Half ripe</td>
<td>7.8</td>
<td>14.62</td>
<td>1.46</td>
</tr>
<tr>
<td></td>
<td>Ripe</td>
<td>3.4</td>
<td>19.36</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Over ripe</td>
<td>3.2</td>
<td>19.7</td>
<td>3.78</td>
</tr>
</tbody>
</table>

Fig. 1 Evolution of \( L^*\),\( C^*\),\( h^0 \) parameters during maturation of Excelsior cultivar

Fig. 2 Evolution of \( L^*\),\( C^*\),\( h^0 \) parameters during maturation of Nicusor cultivar

Fig. 3 Reflectance spectra of Excelsior cultivar in different stages of maturation
Fig. 4 Reflectance spectra of Nicusor cultivar in different stages of maturation.