DOI: 10.52846/bhfe.26.2021.03

ANNALS OF THE UNIVERSITY OF CRAIOVA

Series: ✓*Biology*
✓*Horticulture*
✓ *Food products processing technology*
✓*Environmental engineering*

Vol. XXVI (LXII) - 2021

POST-HARVEST MONITORING OF PEAR FRUIT QUALITY PARAMETERS USING DA-METER

Butcaru Ana Cornelia[1]*, Mihai Cosmin Alexandru[1], Stan Andreea[1], Asănică Adrian Constantin[1], Hoza Dorel[1], Stănică Florin[1]
[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest
* *Corresponding author. E-mail*: anabutcaru@gmail.com

Keywords*: Euras, Romcor, Tudor, Cristal, Corina*

ABSTRACT

This study presents the preliminary results on the non-destructive, DA meter-based optimum harvest maturity models for several Romanian disease resistant pear genotypes, cultivated in the Bucharest area. Six cultivars (Tudor, Cristal, Orizont, Corina, Euras, and Romcor) and three new hybrid selections (R3-146, H12-83-79, and H5-5-84) on their own roots, in vitro propagated, or grafted on quince (CTS 212) and pear (Farold 40) were analyzed. The results bring important details about the post-harvest maturation of the studied pear genotypes using the IAD index. Each cultivar has its maturity index correlated to IAD and consumer preferences and further research is needed to calibrate for each cultivar the optimal harvesting moment and the appropriate IAD value for shelf life after storage.

INTRODUCTION

Although the concept of non-destructive spectral measurements of chlorophyll content to determine fruit maturity is not new, appropriate and convenient equipment is available for several years, proving their quality in different crop technologies. Some of the researches focused on using an absorbance (DA) meter, to measure on-the-tree or immediate post-harvest fruit maturity (the ripening state), to distinguish post-harvest and/or post-storage maturity as a means of segregating fruit into market-relevant quality categories (Honaas et al., 2021; Scalisi et al., 2021; DeLong et al., 2020).

One of the delta absorbance (DA) meters was created by the former Department of Fruit Tree and Woody Plant Sciences of the University of Bologna (Turoni, Italy). The equipment allows to define the ripening stage reached by the fruits, defining a new ripening index, “Absorbance Difference index” (IAD), related to fruit ethylene emission and chlorophyll content degradation (Costamagna et al., 2013; Peifer et al., 2018). The DA meter measures the difference in absorbance between two wavelengths (A670 nm, A720 nm) near the upper absorption peak of chlorophyll a, which is then used to calculate the index of absorbance difference (Turpin et al., 2016; Torres et al., 2018; DeLong et al., 2020; Wang et al., 2021).

This study presents the preliminary results on the non-destructive, DA meter-based optimum harvest maturity models for several Romanian disease resistant pear genotypes, cultivated in the Bucharest area.

MATERIAL AND METHODS

The research was conducted between 2019-2020, at the Research center for studies of food and agricultural products quality, Laboratories of Fruit Growing, and Post-harvest Technologies (University of Agronomic Studies and Veterinary Medicine of Bucharest). The tested pear fruits were harvested in September 2019 from the Experimental field of the Faculty of Horticulture in Bucharest, located in the North part of the town. They were kept in the cold storage until they were analyzed at 1 °C and 85-90% RH.

Six cultivars (Tudor, Cristal, Orizont, Corina, Euras, and Romcor) and three new hybrid selections (R3-146, H12-83-79, and H5-5-84) resistant to scab and on fire blight, or tolerant, on own roots (Or) (*in vitro* propagated), or grafted on quince (Q) (CTS 212) and pear (F) (Farold 40) were analyzed (Table 1).

Table 1

Biological material used in the experiment

Cultivar	Genitors	Ripening period
Corina	Passe Crassane x (B.C. *Pyrus serotina* x Olivier de Serres) x Decana Comisiei	October - November
Cristal	[(Roșior pietros x Decana de iarnă) x Decana de iarnă] x Beurre Hardy	similar to Williams
Euras	(*Pyrus serotina* x Olivier de Serres) x Decana de iarnă	harvesting in October can be consumed until April
Orizont	[(B.C *Pyrus seratina* x Oliver de Serres) x Oliver de Serres] x Josephine de Malines	December – February
Romcor	[Passe Crassane x (*Pyrus serotina* x Oliver de Serres)] x Decana Comisiei	October - January
Tudor	[(*Pyrus serotina* x Decana de iarnă) x Passe Crassane] x 30-44 Angers	similar to Williams

Source: Ghena et al., 2004; Branișteet al., 2008; Andreieș, 2017.

Post-harvest monitoring with Da-meter and biochemical analyses

I_{AD} index was determined for each fruit, from each variant, at the beginning of the experiment and monthly after. When the fruits had under 0.5 I_{AD} index, the basic analyses like total soluble solids, total acidity, dry matter, and firmness were determined and correlated with the I_{AD} index. Total soluble solids were determined for each genotype, with a refractive device Kruss DR301-95 (° Brix). Dry matter and water content of the samples were determined by oven drying for 24 hours at 105°C using a UN110 Memmert oven. Firmness was determined with a digital penetrometer TR Turoni 53205, the results were expressed in kg f/cm^2. An automatic titrator was used to determine total acidity in fruits (Bezdadea Cătuneanu et al., 2018).

RESULTS AND DISCUSSIONS

This study brings important details about the post-harvest maturation of the studied pear genotypes using the I_{AD} index. Most of the Tudor/Q cultivar fruits were kept in cold storage until December (I_{AD} < 0.5). Cristal cultivar fruits were stored until January, quince rootstock printing a higher precocity than Farold 40 (Fig. 1).

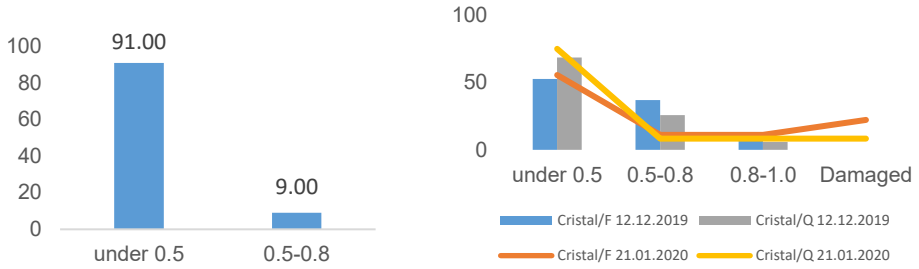

Figure 1. Evolution of I_{AD} index during the post-harvest period at the Tudor/Q (12.12.2019), Cristal/F and Cristal/Q

Orizont, although a cultivar with a late consumption period, reached the maturity level in January, one possible cause being the late harvesting (in December most of the fruits had an I_{AD} index under 1.2). On the contrary, Corina fruits were harvested too early, at an I_{AD} index of more than 2.0. Most of the fruits were damaged in two months, none of them being able to reach the consumption maturity (Fig.2).

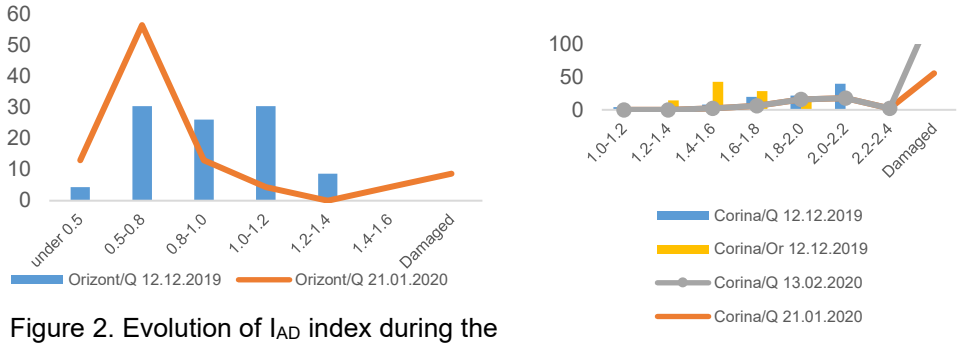

Figure 2. Evolution of I_{AD} index during the post-harvest period at the Orizont/Q, Corina/Q, and Corina/F

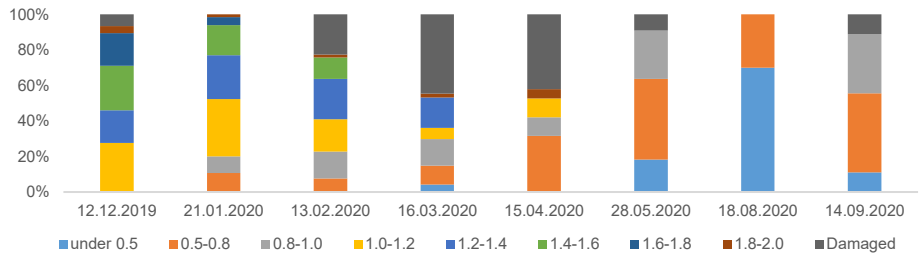

Figure 3. Evolution of I_{AD} index during the post-harvest period at the Romcor/Q

A clone of Romcor/Q maintained the storage qualities for 12 months, until September 2020. The maturity index, in the storage conditions, was obtained beginning with April - May 2020 (six months after harvesting) (I_{AD} < 0.8).

One of the most appreciated cultivars of the Voinesti pear breeding program, Euras, maintained its qualities 11 months for Farold 40 rootstock and 12 months for quince rootstock. (Fig. 4). The I_{AD} > 1.4 at the harvest moment.

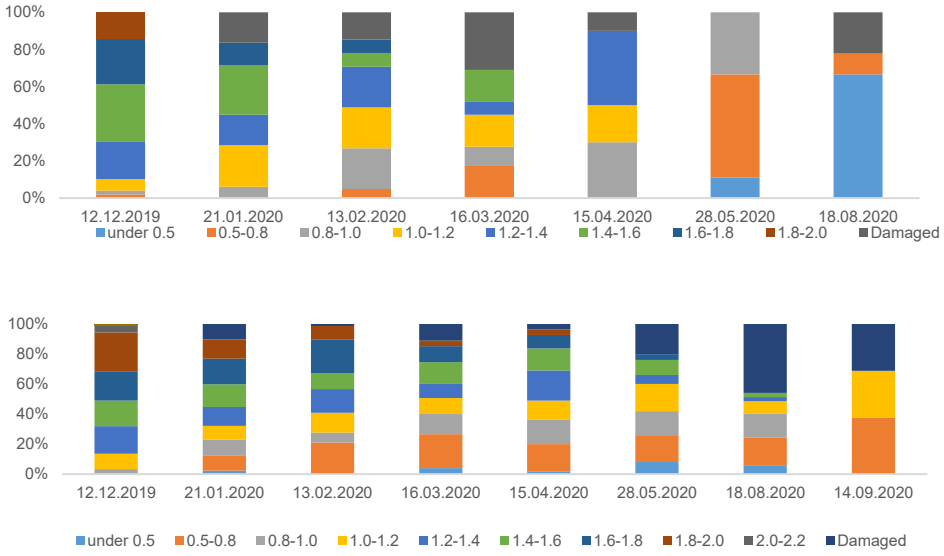

Figure 4. Evolution of I_{AD} index during the post-harvest period at the Euras/F (up) and Euras/Q (down)

A promising hybrid, H12-83-73, could be stored for four months (quince) respectively six months (Farold 40) (Fig. 5), quince rootstock giving a precocity at ripening.

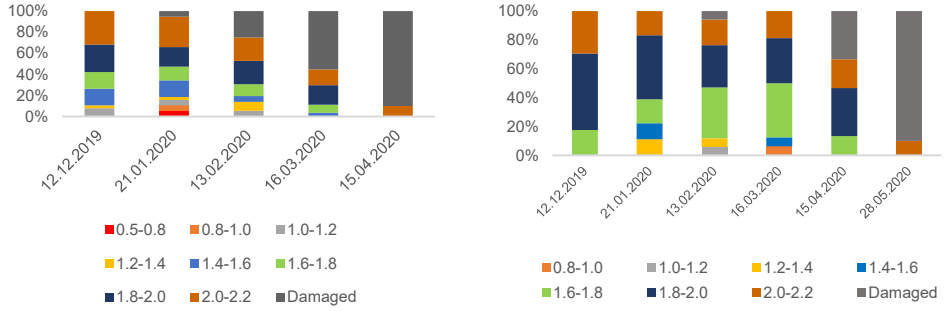

Figure 5. Evolution of I_{AD} index during the post-harvest period at the H12-83-73/Q (left) and H12-83-73/F (right)

H5-5-84 hybrid had a short storage period (until January) and R3-146 hybrid (with very attractive fruits) had seven months storage period (Fig. 6).

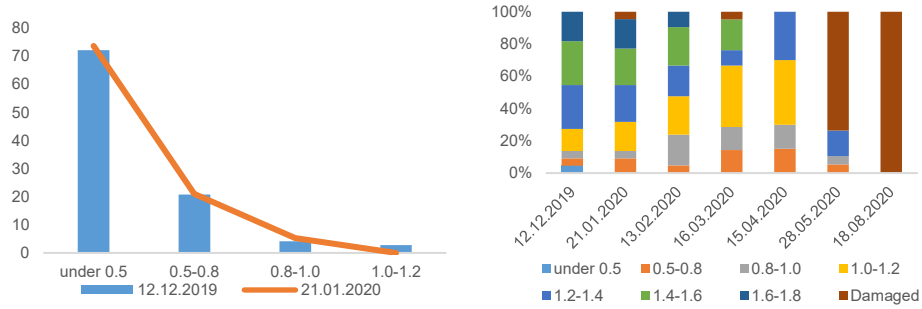

Figure 6. Evolution of I_{AD} index during the post-harvest period at the H5-5-84/Q and R3-146/Q genotypes

The biochemical parameters for some of the genotypes monitored between autumn 2019 – autumn 2020 are presented in Table 2. Although all the fruits were analyzed at an I_{AD} < 0.5 (Euras/F at 0.65), the fruit firmness varied between 2.36 kg f/cm^2 (Cristal/F), 5.48 kg f/cm^2 (Cristal/Q) to 6.75 kg f/cm^2 (H5-5-84/Q). The maturity parameter (TA/TSS) had similar values for Tudor/Q, Cristal/F, and Euras/Q at I_{AD}<0.5.

Table 2

Biochemical parameters of fruits with I_{AD} index under 0.5

Cultivar/ Rootstock	Data	Firmness (kgf/cm2)	TSS	%Fructose	%Glucose	Dry matter	Titrable acidity (g citric acid/100 fwg)	TA/ TSS
Tudor/Q	13.12.2019	2.75	14.25	14.80	14.65	0.17±0.011	0.122±0.001	0.009
Cristal/F	13.12.2019	2.36	11.45	12.00	11.90	0.14±0.002	0.098±0.002	0.009
Cristal/Q	13.12.2019	5.48	18.07	18.83	18.57	0.21±0.021	0.235±0.005	0.013
H5-5-84/Q	13.12.2019	6.75	-	-	-	0.28±0.008	0.168±0.031	-
Orizont/Q	06.02.2020	4.15	17.02	17.50	17.34	0.20±0.002	0.566±0.004	0.033
Romcor/Q	15.04.2020	3.08	12.30	12.47	12.37	0.13±0.010	0.420±0.002	0.034
Euras/Q	15.04.2020	3.54	21.43	21.85	22.03	0.25±0.021	0.204±0.245	0.009
Euras/F*	15.04.2020	4.66	11.53	11.60	11.30	0.14±0.004	0.492±0.016	0.043

*I_{AD} = 0.65

CONCLUSIONS

DA-meter is valuable equipment both in monitoring the level of fruit maturity before harvest and later, during the post-harvest period. Each cultivar has its maturity index correlated to I_{AD} and consumer preferences. Further research is needed to calibrate for each cultivar the optimal harvesting moment and the appropriate I_{AD} value for shelf life after storage.

ACKNOWLEDGMENT

This work was supported by a grant from the University of Agronomic Sciences and Veterinary Medicine of Bucharest, project number 2021-6/2021.07.17 acronym CIRCULAR-ECO-PĂR, within Joint Junior Competition 2021 and project FDI-2021-0430.

REFERENCES

Andreieș N. 2017. Realizări în ameliorarea părului obținute la Stațiunea de Cercetare- Dezvoltare pentru Pomicultură Voinești [Achievements in pear breeding obtained at the Research Station for Fruit Growing Voinești].

Bezdadea Cătuneanu I., Bădulescu L., Dobrin A., Stan A., Hoza D. 2017. The influence of storage in controlled atmosphere on quality indicators of three blueberries varieties. Scientific Papers. Series B, Horticulture, LXI. 91-100.

Branişte N., Andrieş N., Ghidra V. 2008. Pear genetic breeding to improve the Romanian varieties. Acta Horticulturae, 800, 491-496.

Costamagna F., Giordani L., Costa G., Noferini M. 2013. Use of AD index to define harvest time and characterize ripening variability at harvest in 'Gala' Apple. Acta Horticulturae 998, 117-123.

DeLong J., Harrison P., Harkness L. 2020. An optimal harvest maturity model for 'Minneiska' apple fruit based on the delta-absorbance meter. The Journal of Horticultural Science and Biotechnology, DOI: 10.1080/14620316.2020.1728199

Ghena N., Braniște N., Stănică F. 2004. General Pomology. Bucharest: Matrix Rom Publishing House.

Honaas L., Hargarten H., Hadish J., Ficklin S. P., Serra S., Musacchi S., Wafula E., Mattheis J., dePamphilis C. W., Rudell, D. 2021. Transcriptomics of differential ripening in 'd'Anjou' pear (*Pyrus communis* L.). Frontiers in plant science, 12, 609-684.

Peifer L., Ottnad S., Kunz A., Damerow L., Blanke M. 2018. Effect of non-chemical crop load regulation on apple fruit quality, assessed by the DA-meter. Scientia Horticulturae, 233, 526-531.

Scalisi A., O'Connell M.G. 2021. Application of visible/NIR spectroscopy for the estimation of soluble solids, dry matter and flesh firmness in stone fruits. J Sci Food Agric, 101: 2100-2107.

Torres C.A., Valdivia A., Jorquera G., Hernandez O. 2019. The use of DA meter to assess apple and pear maturity in Chile. Acta Hortic. 1256, 63-70.

Turpin S.R., Stefanelli D., Jones L., Norton J., Probst R., Konings J., Langford, G. 2016. Perfect pears for the next generation of consumers. Acta Hortic. 1120, 507-514.

Wang D., Ding C., Feng Z., Ji S., Cui D. 2021. Recent advances in portable devices for fruit firmness assessment, Critical Reviews in Food Science and Nutrition, DOI: 10.1080/10408398.2021.1960477.