The influence of some calcium chloride products on post-harvest apple quality

Radu Sumalan[a], Dorin Camen [a], Florin Viliga [a], Laura Suciu[a]

a - Faculty of Horticulture, Banat's University of Agricultural Science and Veterinary Medicine Timisoara,Calea Aradului no. 119, Timisoara, Romania
e-mail: plantphysiology.ro@gmail.com

Abstract

The optimal time for harvesting is determined by the output destination: fresh consumption, industrialization, etc. For good fresh fruit consumption, harvest maturity is determined differently depending on species, variety, storage conditions, remoteness of consumer etc. In this experiment we studied the influence of some products based on calcium chloride upon 2 varieties of apple fruit from market in the west of Romania. For this purpose, immature fruits were harvested and stored in different temperature conditions. The following quality parameters were determined: fruit firmness, soluble carbohydrate content and starch test.

Introduction

The term "post-harvest treatment" is to some extent misleading because, as every manufacturer knows, apple treatments do not begin only after harvest but at the beginning of production, when selecting varieties of fruits and vegetables to be produced (Bucarciuc, 1991). Choosing apple varieties – with long-term preservation characteristics and resistance to transportation - is as important as any other work or process carried out in the orchard before harvesting or during handling and storage of fruits after harvest (Molina, 2006; Taya Pineiro, 2007). Across the globe, many countries set quality standards for fruits and vegetables that are imposed by law. To be marketed in those countries, fruits and vegetables must meet these standards (Unay, 2004).

Materials and methods

For testing Timac specific products for apples we decided to use the following varieties: **GENEROS** and **FLORINA** (Figure 1).

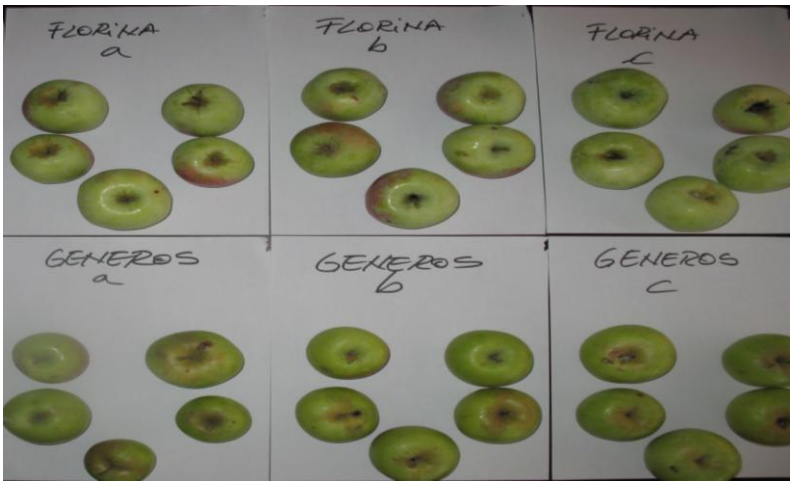

Figure 1. Studied apple varieties

The experiment was located in the Experimental Teaching Resort at USAMVB Timisoara on a total surface of 1440 m^2 using randomized blocks in plots of 80 m^2 and having 3 repetitions.

We used the following experimental variants: **a** - treatment with **calcium chloride** (control); **b -** treatment with **ELITE**; **c -** treatment with **RDM.** Treatments were performed at different stages of vegetation expressed with BBCH code (Table1) as follows:

Table1. Treatments applied

Treatment	Phenophase
Calcium chloride ,Elite, RDM	74 BBCH
Calcium chloride ,Elite, RDM	77 BBCH
Calcium chloride ,Elite, RDM	79 BBCH
Calcium chloride	81 BBCH
Calcium chloride	85 BBCH
Calcium chloride	89 BBCH

The main indices followed were: soluble carbohydrate content (digital refractometer), fruit firmness (penetrometer). Maturity starch-iodine test (AI) - This is a reliable method for determining the maturity of most varieties of apples and is the simplest indicator of apple ripeness. When the apples begin ripening, naturally accumulated starch turns into glucose. Fruits were stored / maintained in the following conditions: air-conditioned containers at a temperature of 4 º C; refrigerated containers at a temperature of 17 º C; room temperature: 27° C, during 12 days.

Results and discussions

Results regarding the determination of soluble carbohydrates content for the studied genotypes in BBCH 81 vegetation stage.

Table 2. Total content of soluble carbohydrates at Generos genotype

EXPERIMENTAL VARIANT	SOLUBLE CARBOHYDRATES CONTENT (%)									
	HARVEST MOM.	12 DAYS								
		27°C			17°C			4°C		
		VAL.	DIF.	%	VAL.	DIF.	%	VAL.	DIF.	%
CALCIUM CHLORIDE	10,65	14,6	3,95	37,09	13,41	2,76	25,92	13,1	2,45	23,00
ELITE	12,95	15,8	2,85	22,01	14,41	1,46	11,27	13,6	0,65	5,02
RDM	11,45	14,9	3,45	30,13	13,81	2,36	20,61	12,4	0,95	8,30

Regarding the soluble carbohydrates content (Table 2), an increase can be seen as followed: for **control** (calcium chloride) after 12 days of storage was found that for high temperatures (27 °C) the registered increase was of 37,09 % for Generos genotype, furthermore 25,92 % for fruits stored at 17 °C and 23 % for those stored at 4 °C. For Florina genotype the increase in soluble carbohydrates content has the following distribution: 21,91 % for fruits stored at 27°C, 10,84% for fruits stored at 17°C and 7,57% for those stored at 4°C. When applied the **Elite** fertilizer, the following differences were observed: for Generos genotype an increase of 22,01 % in soluble carbohydrates content for fruits held at 27°C, 11,27 % for fruit held at 17 °C and 5,02 % for those stored at 4 °C.

Table 3. Total content of soluble carbohydrates at Florina genotype

EXPERIMENTAL VARIANT	SOLUBLE CARBOHYDRATES CONTENT (%)									
	HARVEST MOM.	12 DAYS								
		27°C			17°C			4°C		
		VAL.	DIF.	%	VAL.	DIF.	%	VAL.	DIF.	%
CALCIUM CHLORIDE	12,55	15,3	2,75	21,91	13,91	1,36	10,84	13,5	0,95	7,57
ELITE	11,05	14,8	3,75	33,94	13,11	2,06	18,64	12,81	1,76	15,93
RDM	9,05	13,1	4,05	44,75	12,95	3,9	43,09	11,4	2,35	25,97

Florina genotype had the following distribution regarding the soluble carbohydrates content and storage conditions: the fruits held at a temperature of 27 °C registered with 33,94 % more carbohydrates than at harvest, those stored at 17 °C had with 18,64 % more and the fruits held at 4 °C registered an increase of 15,93 %. For the experimental variant were **RDM**

fertilizer was applied the results are: Generos genotype registered an 30,13 % increase of carbohydrates when fruits were stored at a temperature of 27°C, 20,61 % for fruits stored at 17 °C and only 8,30 % when the fruits were stored at a temperature of 4 °C.

In case of Florina genotype (Table 3) at 12 days after harvest the carbohydrate percentage was with 44,75 % higher for fruit stored at 27 °C. When kept at a temperature of 17°C the increased percentage was 43,09 % and fruits exposed to 4 °C showed a percentage increase of 25,97 % from time of harvest.

Experimental results regarding the determination of fruit firmness for studied genotypes in BBCH 81 vegetation stage

Table 4 Fruit firmness for Generos genotype

EXPERIMENTAL VARIANT	FRUIT FIRMNESS (lbs)									
	HARVEST MOM.	12 DAYS								
		27°C			17°C			4°C		
		VAL.	DIF.	%	VAL.	DIF.	%	VAL.	DIF.	%
CALCIUM CHLORIDE	12,48	7,81	-4,67	-37,42	10,18	-2,3	-18,43	11,13	-1,35	-10,82
ELITE	13,63	6,4	-7,23	-53,04	10,73	-2,9	-21,28	11,68	-1,95	-14,31
RDM	12,84	6,45	-6,39	-49,77	10,33	-2,51	-19,55	11,15	-1,69	-13,16

Regarding fruit firmness after 12 days of storage the following results were registered: for **control** (calcium chloride) when harvested the fruit from **Generos** variety had a 12,48 lbs firmness, for the experimental variant were **Elite** fertilizer was applied the fruit presented a 13,63 lbs firmness and those treated with **RDM** had 12,84 lbs (Table 4). After being stored for 12 days at different temperatures, their firmness modified as follows: fruit held at a temperature of 27 °C registered a 37,42 % percentage decrease in firmness, for **control** variant, fruit stored at 17 °C the decreased percentage was 18,43 % and those stored at 4 °C have a decrease in firmness of 10,82%. For the experimental variant treated with **Elite** fertilizer, fruit stored at a temperature of 27 °C registered a 53,04 % decrease in firmness, at 17 °C the decrease was of 21,28 % and those stored at 4 °C presented a decrease in firmness of 14,31 %. In the case of fruit were **RDM** fertilizer was applied their firmness decreased with 49,77 % for fruit stored at 27 °C, for those kept at 17 °C the decrease was of 19,55 % and for fruit kept at 4 °C the percentage was of 13,16 %.

Table 5 Fruit firmness for Florina genotype

EXPERIMENTAL VARIANT	FRUIT FIRMNESS									
	HARVEST MOM.	12 DAYS								
		27°C			17°C			4°C		
		VAL.	DIF.	%	VAL.	DIF.	%	VAL.	DIF.	%
CALCIUM CHLORIDE	16,7	6,22	-10,48	-62,75	11,86	-4,84	-28,98	12	-4,7	-28,14
ELITE	16,46	6,34	-10,12	-61,48	12,41	-4,05	-24,61	11,9	-4,56	-27,70
RDM	16,91	7,68	-9,23	-54,58	12,88	-4,03	-23,83	12,38	-4,53	-26,79

For **control** (calcium chloride) at harvest time the fruit from **Florina** genotype presented a 16,7 lbs firmness, for the variant were **Elite** fertilizer was applied the firmness was of 16,46 lbs and for **RDM** the value was of 16,91 lbs. After being stored for 12 days in different temperature conditions (Table 5), fruit firmness suffered modifications like: the fruits stored at 27 °C registered a decrease in firmness of 62,75 % for **control**, those stored at 17 °C a decrease of 28,98 % and the fruit stored at 4 °C a decrease in percentage of 28,14 %. The experimental variant were **Elite** fertilizer was applied had the following influence in regarding the fruit firmness: a decrease of 61,48 % in fruit firmness was established after being stored at 27 °C, 24,61 % for the fruit stored at 17 °C and 27,70 % for those stored at 4°C. For the fruit were **RDM** treatment was applied the firmness decreased with a percentage of 54,58 % after the fruits were stored at 27 °C, with 23,83 % for fruit kept at 17 °C and with 26,79 % after the fruit were stored at 4°C.

Experimental results regarding maturity starch-iodine test (AI) in BBCH 81 vegetation stage.

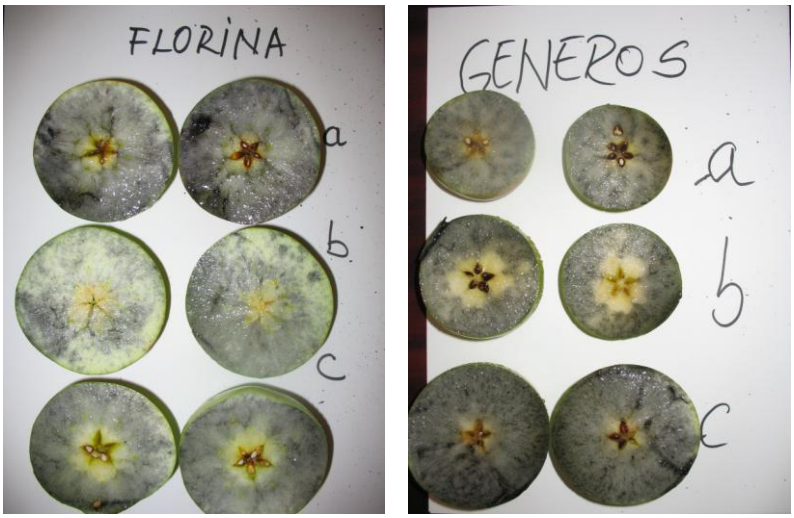

Figure 2. Maturity starch-iodine test (AI) at harvest – BBCH 81 vegetation stage

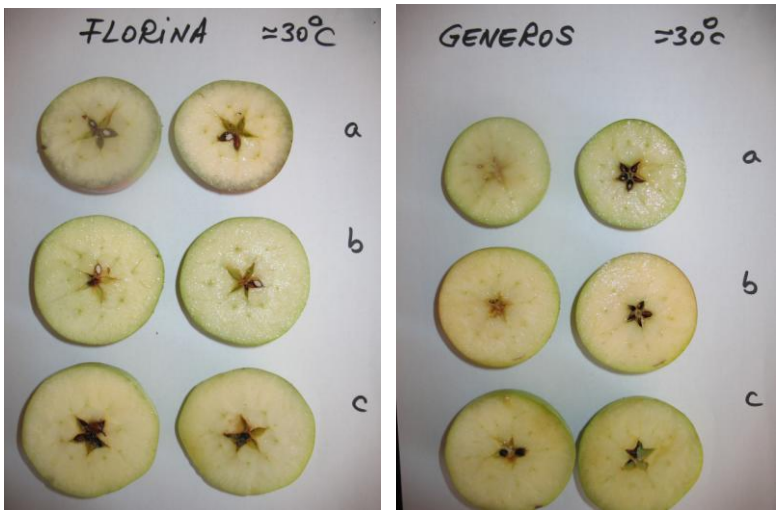

Figure 3. Maturity starch-iodine test (AI) – fruit stored at 27 °C

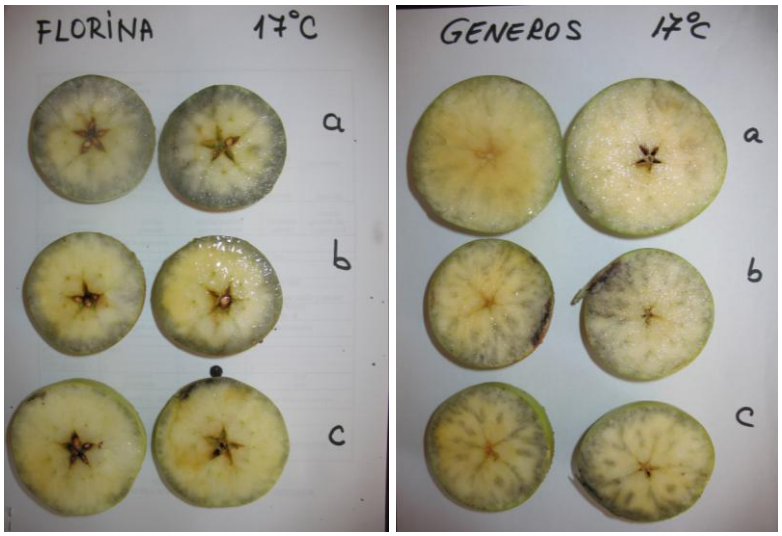

Figure 4. Maturity starch-iodine test (AI) – fruit stored at 17 °C

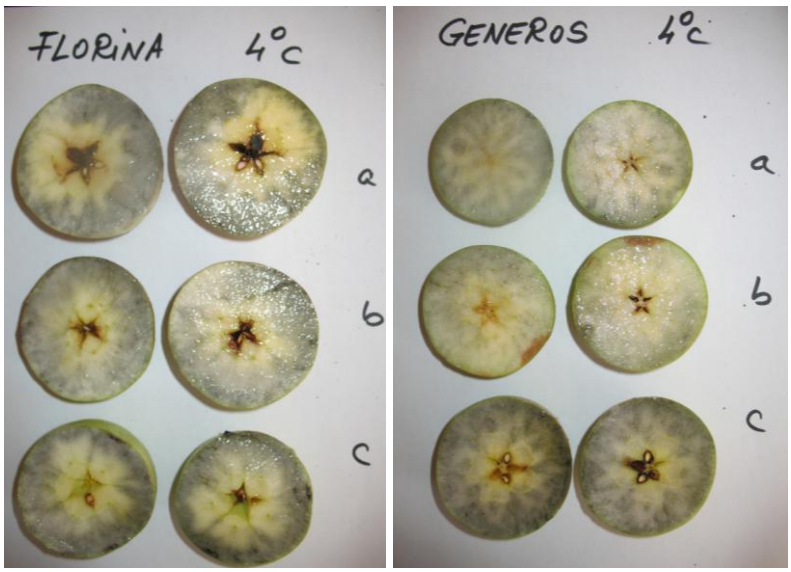

Figure 5. Maturity starch-iodine test (AI) – fruit stored at 4 °C

By comparing the charts of the maturity starch-iodine test results can be seen that at harvesting all the fruit had maximum starch content (Figure 2).

After their exposure to a temperature of 27 °C in the maturity starch-iodine test can be seen that the soluble carbohydrate content increases and there are no visible surfaces that present starch iodide (Figure 3). In regarding the experimental variant were the fruit was stored at 17 °C for 12 days (Figure 4) for **control** (calcium chloride) in Florina cases an increase of starch can be observed. In Generos case the highest increase in starch content (Figure 5) can be observed were RDM was applied for fruit stored at 4 °C.

References

Bucarciuc V.F., 1991. Apple production in the world. Journal Pomicultura, viticultura şi vinificaţia în Moldova, 6, 2-5

Unay D., Gosselin B., 2004. A quality grading approach for jonagold apples. Proc. of the IEEE Benelux Signal Proc. Symp., Hilvarenbeek, 93.96.

Molina D., Alegre S., Casero T., CasalsM., Bonany J., Carbo J., Puy J.,Recasens I., 2006. Quality indexes for 'Golden Smoothee' apples in relation to consumer evaluation. J. Fruit Ornam. Plant Res, 14 (2), 39-51.

Pineiro T., Luz R, 2007. Food quality and Standard Service. Nutrition and Consumer Protection Devision, F.A.O.Rome.