

PRELIMINARY RESULTS REGARDING MAINTAINING OF THE QUALITY AFTER HARVESTING OF THE APRICOTS

REZULTATE PRELIMINARE PRIVIND MENȚINEREA CALITĂȚII CAISELOR DUPĂ RECOLTARE

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Abstract. *The aim of this paper is to establish the influence of variety and storage conditions on the preserving capacity after harvesting of the apricots. The paper presents the results obtained in 2016 on quality maintaining of the apricots. There were studied two Romanian varieties of apricots, created from Research Station for Fruit Growing (R.S.F.G) Constanta - Mamaia and Olimp. Apricots were kept at Research and Development Institute for Processing and Marketing of the Horticultural Products Bucharest, in different technological conditions: ambient temperature (20-22°C); temperature of 10-12° C (refrigerated conditions), with and without modified atmosphere and temperature of 3-5°C (cold storage). The initial level and the evolution during storage of the firmness of the fruits and of the main biochemical components: soluble dry matter, soluble carbohydrates, titratable acidity and vitamin C were determined. After storage determinations were performed on the total losses, quantitative losses (expressed by evaporate-transpiration) and qualitative depreciations. The results revealed the fact that, in general the apricots were sensitive to storage, the maximum storage duration being 5-20 days, depending on the storage conditions. The two main problems were represented by the mass losses, which caused the wrinkle of the fruit and the injuries, which mostly affected the appearance and the consumption quality. The losses by impairment were between 0 to 22.5%, depending on the variety, conditions and duration of storage. The depreciation of the apricots during storage was caused in most cases by the attack and the development of diseases (Botrytis, Penicillium, Phytophthora etc), which have spread rapidly in the fruit mass. The apricots of Mamaia variety were more resistant to storing than Olimp variety, which degraded faster and more than the others. The most favorable conditions for the maintaining of the quality have been shown to be temperature of 10-12° C (refrigerated conditions), with modified atmosphere (5% CO₂-enriched), in which apricots have recorded, after 20 days of storage, quantitative losses of less than 0.5% and losses by impairment of 0-2.78%, depending on variety.*

Key words: storage conditions, biochemical components, quantitative and the qualitative losses

Rezumat. *Scopul acestei lucrări este stabilirea influenței soiului și condițiilor din timpul păstrării asupra capacității de păstrare a calității după recoltare a caiselor. Lucrarea prezintă rezultate obținute în anul 2016 cu două soiuri de caise românești, Mamaia și Olimp, create la SCD Constanța. Caisele au fost păstrate la Institutul de Cercetare și Dezvoltare pentru Industrializarea și Marketingul Produselor Horticole*

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*București, în diferite condiții tehnologice: temperatura mediului ambiant (20-22°C); temperatura de 10-12°C (condiții de refrigerare), cu sau fără atmosferă modificată și temperatura de 3-5°C (la frig). A fost determinat nivelul inițial și evoluția pe durata păstrării a fermițății fructelor și a principalelor componente biochimice a caiselor: substanța uscată solubilă, glucide solubile, aciditatea titrabilă și vitamina C. După scoaterea de la păstrare au fost stabilite pierderile totale, pierderile de masă și pierderile prin stricare ale fructelor. Rezultatele au scos în evidență faptul că, în general, caisele au fost sensibile la păstrare, durata maximă de păstrare fiind de 5-20 zile, în funcție de condițiile de păstrare. Principalele două probleme le-au reprezentat pierderile de masă, care au determinat zbarcirea fructelor la exterior și cele prin stricare, care au afectat în cea mai mare măsură aspectul și calitatea de consum. Pierderile prin stricare au fost între 0-22,5%, în funcție de soi, condițiile și durata de păstrare. Deprecierea caiselor în timpul păstrării a fost cauzată în majoritatea cazurilor de atacul și dezvoltarea unor boli (*Botrytis*, *Penicillium*, *Phytophthora* etc.) care s-au răspândit rapid în masa de fructe. Caisele din soiul Mamaia au fost mai rezistente la păstrare decât ale soiului Olimp, care s-au depreciat mai repede și mai mult decât celelalte. Condițiile cele mai favorabile menținerii calității s-au dovedit a fi spațiile refrigerate și cu atmosferă modificată îmbogățită în CO₂ (5%), în care caisele au înregistrat, după 20 zile de păstrare, pierderi de masă de sub 0,5% și pierderi prin stricare de 0-2,78%, în funcție de soi.*

Cuvinte cheie: condiții de păstrare, componente biochimice, pierderi cantitative și calitative

INTRODUCTION

Apricots are very popular with consumers, both as a dessert fruit and as well as processed in various ways. The high demand for fruits is determined by their qualitative and technological attributes, by the complex biochemical composition and by the very pleasant taste and specific flavor etc (Akin *et al.*, 2008; Alexe, 2017)

There are many apricot consumption benefits that are also supported by scientific studies. Firstly, they are a real and rich source of vitamin A, B and C, along with beta carotene (due to which the color is yellow-orange) helps maintain eyesight and nerves and tissue regeneration (www.pro-sanatate.com/caisele-beneficii...).

But in the biochemical composition of fruits there are several other important components for the human nutrition. High nutritional value of apricots and apricot-based finished products, led specialists in the scientific research domain to diversify the assortment by creating or placing cultivars in the tillage that behave well in the climatic conditions from Romania.

Apricots are extremely perishable, which raises serious problems concerning the maintaining of their quality during the valorisation process, from the moment they are harvested until they reach the consumer. Being highly perishable, apricots are typically consumed or canned within two weeks of harvest.

In our country not many data on the storage of apricots in refrigerated and controlled atmosphere (CA) are available in the literature, especially concerning the effect of CO₂ level in CA. In Italy, Europe's main producer of apricots, Andrich and Fiorentin (1986) studied two varieties of apricots to determine their storability and to examine the effect of the CO₂ level on weight decrease,

firmness, total titratable acidity, pH, refractometric degree and physiological and pathological changes. In other countries the researchers determined effects of controlled atmosphere storage and ethylene on specific biochemical changes in apricot fruits (Brecht *et al.*, 1982; Bartley, 1970; Palou and Crisosto, 2003).

The aim of this work is to establish the influence of variety and storage conditions on the preserving capacity after harvesting of the apricots belonging to two of the selected cultivars: Mamaia and Olimp.

MATERIAL AND METHOD

The experience includes a total of 8 experimental variants. The factors of the storage experience were the variety and storage conditions. Apricots were harvested and introduced in experimentation in 2016, coming from Research Station for Fruit Growing (R.S.F.G) Constanta. The scheme of the organization of experience with the apricots storage is shown in table 1.

Table 1

Experimental scheme for preserving of the apricot

Variant	Variety	Storage conditions *
V1	MAMAIA	20-22°C
V2	-idem-	10-12 °C
V3	-idem-	10-12 °C+MA
V4	-idem-	3-5 °C
V5	OLIMP	20-22°C
V6	-idem-	10-12 °C
V7	-idem-	10-12 °C+MA
V8	-idem-	3-5 °C

* Legend: MA= modified atmosphere

Aspects regarding the organization of the experiment are presented in figure 1.

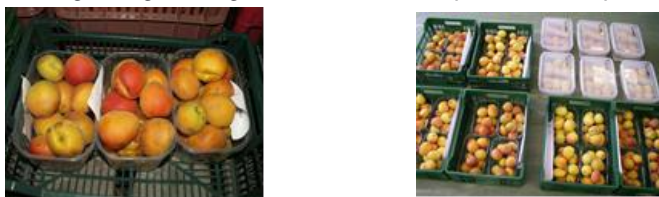


Fig. 1 Aspects of the organization of the experiment

Before placing the storage, biometric measurements were made, having regard to: average fruit weight, height, diameter and index form.

There have been determined the initial level and the evolution during storage of some biochemical components: soluble dry matter, total sugar, titratable acidity and vitamin C. Aspects of the varieties are shown in figure 2.



Fig. 2 Appearance of apricot varieties

RESULTS AND DISCUSSIONS

The results regarding the biometric data of the apricots are presented in Table 2, which shows that they are relatively close, as size, shape and weight of the fruits, average weight, the fruits of variety Mamaia being however larger with 3,52 g compare with those of variety Olimp.

Table 2

Biometric data of the apricots					
No.	Variety	Height (mm)	Diameter (mm)	Shape index	Average weight (g/fruit)
1	MAMAIA	46.3	42.9	0.93	51.12
2	OLIMP	43.6	40.2	0.92	47.60

The data on the evolution of apricots losses during storage are presented in table 3. The storage duration of the apricots was: 5 days when they stored at a temperature of 20-22° C, 15 days for storage at 10- 12° C and 20 days when the temperature was 3-5° C.

Table 3

Losses of the apricots during storage (%)						
Variant	Variety	Storage conditions (°C)	Storage duration (days)	Mass losses (%)	Depreciation losses (%)	Total losses (%)
V1	MAMAIA	20-22°	5	17.91	5.00	22.91
V2	- idem-	10-12 °C	15	12.10	12.50	24.60
V3	- idem-	10-12 °C+MA	15	0.26	0	0.26
V4	- idem-	3-5 °C	20	19.26	5.55	24.81
V5	OLIMP	20-22°	5	18.23	20.00	38.23
V6	-idem-	10-12 °C	15	14.23	22.50	36.73
V7	-idem-	10-12 °C+MA	15	0.32	2.78	3.10
V8	-idem-	3-5 °C	20	22.46	7.50	29.96
Average		20-22°	5	18.07	12.50	30.57
		10-12 °C	15	13.17	17.50	30.67
		10-12 °C+MA	15	0.29	1.39	1.68
		3-5 °C	20	20.86	6.53	27.39

Apricots stored at ambient temperature were recorded, after 5 days, mass losses from 17.91% for the variety Mamaia, up to 18.23% for the variety Olimp, qualitative losses of 5.00% for Mamaia variety, to 20.00% for Olimp variety and total losses from 22.91% (Mamaia) to 38.23% (Olimp). Variant V5 of Olimp variety kept warmed presented the lowest values of the weight losses, depreciation and total losses, of all the experimented variants. The difference between the two varieties consist mainly in the level of losses due to spoilage, which was 4 times lower in the Mamaia variety.

The aspect of the apricot of Mamaia variety kept for 5 days at ambient temperature is shown in figure 3.

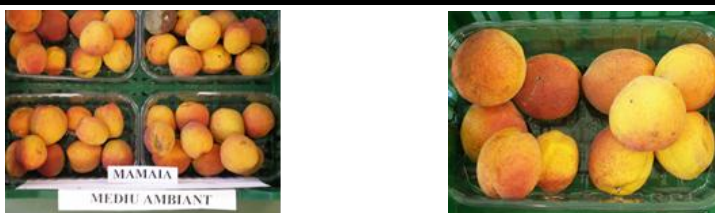


Fig. 3 Aspect of the apricot kept at ambient temperature

The general appearance of apricot Mamaia variety kept for 15 days under refrigeration conditions is shown in figure 4.



Fig. 4. Appearance of apricots kept under refrigeration conditions

At temperature of 10-12°C the tomatoes were recorded, after 15 days of storing, from 12.10% (Mamaia variety), till 14.23% (Olimp variety) mass losses, from 12.50% for the variety Mamaia till 22.50% for Olimp variety depreciation losses, and from 24.26% (Mamaia variety) to 36.73% (Olimp variety) total losses. The level of loss due to damage, which was almost double in the Olimp variety, made mainly the difference between the two varieties in terms of storage resistance under given conditions.

The accumulation of an increased concentration of CO₂ in modified atmosphere conditions carried out in the sealed containers located in room with a temperature of 10-12°C, resulted in registration after 15 days of storage of the apricots to: mass losses of 0.26 (Mamaia variety) to 0.32% (Olimp variety), losses by impairment of 0 for the variety Mamaia and 2.78% to variety Olimp and total losses of 0.26% for the variety Mamaia and of 3.10% to Olimp variety.

The CO₂ concentration of the air in the storage container was maintained around 5% over the entire duration of the tomatoes storage. In these conditions both variants with modified atmosphere (V3 and V7) were recorded, after a storage period of 15 days, the mass losses extremely low (below 1%) due to the air tight volume in special containers. Also the depreciation losses were among the lowest, which is below the level of other variant of work. The fruits of Mamaia variety, being completely free of mass losses and with only 0.26% depreciation represented a real technological revelation, the V3 variant offering the best storage results of the whole apricot experience.

The appearance of Mamaia apricots variety kept for 15 days under

refrigeration conditions and modified atmosphere is shown in figure 5.



Fig. 5 Appearance of apricots kept under refrigeration and modified atmosphere conditions

At a temperature of 3-5° C the apricots preserved for 20 days were recorded, from 19.26% for Mamaia variety up to 20.86% for Olimp variety mass losses, from 5.55% (Mamaia variety) up to 7.50% (variety Olimp) depreciation losses and from 24.81% for Mamaia variety, to 29.96% for Olimp variety, total losses. And in these cold conditions, Mamaia variety, by V4 variant, presented lower losses than V8 variants of the Olimp variety, which had higher rates of mass, spoilage and total losses.

If under given refrigeration conditions, the level of impairment losses it was a reasonable one, that of the mass losses was highest in the whole experience, representing about 1/5 of the initial mass of the stored product. It entailed mostly on the level of total losses, which thus increased to 25-30% depending on the variety.

The results regarding the initial level and evolution of some chemical components during storage of the apricots are shown in table 4.

Table 4

Initial level and evolution of chemical components during storage of the apricots

Variant	Variety	Storage conditions (°C)	Soluble solids (%)	Acidity (%)	Total sugar (%)	Vit.C mg/100g
	MAMAIA	initial	12.2	0.39	5.48	12.40
V1	- idem-	20-22°	14.6	0.33	6.40	10.72
V2	- idem-	10-12 °C	14.2	0.30	6.21	12.14
V3	- idem-	10-12 °C+MA	13.7	0.33	5.86	12.74
V4	-idem-	3-5 °C	15.1	0.22	6.50	12.24
	OLIMP	initial	13.9	0.49	6.21	16.96
V5	-idem-	20-22°	15.3	0.29	7.14	13.30
V6	-idem-	10-12 °C	14.7	0.36	6.40	15.39
V7	-idem-	10-12 °C+MA	11.2	0.52	4.34	13.18
V8	- idem-	3-5 °C	15.6	0.26	6.86	15.46
Average		initial	13.05	0.44	5.85	14.68
		20-22°	14.95	0.31	6.77	12.01
		10-12 °C	14.45	0.33	6.31	13.77
		10-12 °C+MA	12.45	0.43	5.10	12.96
		3-5 °C	15.35	0.24	6.68	13.85

The data presented in table, shows that initially, in placing in storage, the apricots had a content of 12.2 to 13.9% soluble solids, titratable acidity from 0.39 to 0.49%, from 5.48 to 6.21% total sugar and 12.40-16.96 mg / 100g vitamin C, depending on the variety. Olimp variety had the higher content of soluble dry

substance, titratable acidity, total sugar and vitamin C than Mamaia variety.

The content of the soluble dry substance presented, during storage, especially, increases. They were smaller or larger, depending on variant. The highest increases occurred in varieties V4 and V8 (cold storage), when values of 15.1-15.6% were determined, according to the variant of the storage. The lowest soluble dry substance content was determined for variants V3 and V7, for refrigerated conditions, with modified atmosphere.

The acidity of apricots decreased to the majority of variants of preservation compared to initial values, but in varying proportions, depending on variety, duration and storage conditions. The highest decrease in acidity was recorded in the V4 and V8 variants - apricot kept under refrigeration conditions, the level of acidity being of 0.22-0.26% depending on the variety. The higher values of acidity were identified in the variants V3 and V7 - refrigeration storage with modified atmosphere. The apricots of Mamaia variety maintained better the level of the acidity during storage, compared to the Olimp variety.

Total sugar content increased during apricot preservation in most cases, the volume of these increases being different depending on the variant of storage. The higher increases in total sugar content occurred, in both varieties, either in V1 and V6 variants - apricots stored at ambient temperature or in V4 and V8 variants- refrigeration storage, the smallest increase or even a decrease being recorded to variants V3 and V7 - refrigeration storage with modified atmosphere. In the other variants of storage, the increases in sugar content were at average values very close to each other.

Evolution of vitamin C content was different, showing in particular decreases in content and a slight increase in V3 variant - refrigeration storage with modified atmosphere. The two varieties generally had similar developments under similar storage conditions. The results of the initial level and evolution of apricot firmness during storage are shown in table 5.

Table 5.

Level and evolution of apricot firmness during retention

Variant	Variety	Storage conditions (°C)	Firmness (PU)*	Decrease of firmness (%)
	MAMAIA	initial	70.13	-
V1	- idem-	20-22°	111.80	-59
V2	- idem-	10-12°	113.45	-62
V3	- idem-	10-12 °C+MA	93.05	-33
V4	- idem-	3-5°	103.03	-47
	OLIMP	initial	68.35	-
V5	- idem-	20-22°	110.90	-64
V6	- idem-	10-12°	118.40	-73
V7	- idem-	10-12 °C+MA	111.45	-63
V8	- idem-	3-5°	99.90	-46
Average		initial	69.24	-
		20-22°	111.35	-61
		10-12°	115.93	-67
		10-12 °C+MA	102.25	-48
		3-5°	101.47	-47

* PU-Penetrometer Unit = 0.1mm

The data in the table shows that the initial firmness of apricots in the two varieties showed close values, suggesting also similar degrees of fruit maturity. During storage, a reduction in firmness was found in all variants, but in different proportions depending on the storage variant, from 33% to 73%. The highest reduction in firmness occurred in V2 and V6 variants of fruit - storage under refrigeration conditions and the lowest decrease occurred to variant V3, followed by V4 and V6 variants – refrigeration storage. The data also show that in Olimp variety the decrease in firmness was more pronounced than in Mamaia variety in most variants, confirming the better conservation results recorded by the apricots of Mamaia variety.

CONCLUSIONS

The results revealed the fact that, in general the apricots were sensitive to storage, the maximum storage duration being 5-20 days, depending on the storage conditions.

The two main problems were represented by the mass losses, which caused the wrinkle of the fruit and the injuries, which mostly affected the appearance and the consumption quality.

The losses by impairment were between 0 to 22.5%, depending on the variety, conditions and duration of storage. The depreciation of the apricots during storage was caused in most cases by the attack and the development of diseases (Botrytis, Penicillium, Phytophthora etc), which have spread rapidly in the fruit mass.

The apricots of Mamaia variety were more resistant to storing than Olimp variety, which degraded faster and more than the others.

The most favorable conditions for the maintaining of the quality have been shown to be the temperature of 10-12° C (refrigerated conditions), with modified atmosphere (5% CO₂-enriched), in which apricots have recorded, after 20 days of storage, quantitative losses of less than 0.5% and losses by impairment of 0-2.78%, depending on variety.

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