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ASPECTS REGARDING THE QUALITY EVOLUTION OF SOME APRICOT FRUIT VARIETIES DEPENDING ON THE STORAGE CONDITIONS

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Abstract

For apricot fruits an important problem is to define the optimal picking time, the best storage variant and the variety availability for storage as to avoid having different quality levels between on–tree and in-store maturity. In response to this problem and some others that may arise, the research was performed in the orchard of the University of Agronomic Sciences and Veterinary Medicine of Bucharest. Early results have revealed that fruits from 9 apricot cultivars evaluated towards maturity in all the storage variants: NA-normal atmosphere (T=26°C), CA-cold atmosphere (T=2-3°C, relative humidity 78 to 83%) and MA-modified atmosphere (T=2-3°C, relative humidity 85 to 90%) by wrapping the storage case in plastic film. The MA storage variant may be positively considered since the total losses (both in quantity and quality) were lower than in the NA and CA variants. The best response to temporary storage was found in the late maturing varieties 'Favorit', 'Olimp' and 'Excelsior' and in the semi-early maturing variety 'Dacia', the storage period length being of 8 days in NA, 14 days in CA and 30 days in MA.

Key words*: modified atmosphere, rottenness, storage condition.*

INTRODUCTION

The present day opinion considers that the main elements defining the quality of apricots, mainly of those with double destination (fresh consumption and industrial processing) are the following: dry substance content of 18 - 20% and over 20%, titratable acidity of 1 to 2%, vitamin C of 20 - 25 mg/100 g, proteins 2 to 2.5%, pectines 0.7 to 1%, average fruit weight of 65 to 80 g and over 80 g, appealing appearance, authentic apricot fragrance (Alejandro Perez-Pastor et al., 2007).

The question that arises here is about the correlation that may be carried forth between the levels obtained by the components of fruit quality of valuable cultivar at wax ripeness and at on - tree maturity and at in-store maturity stages (Hitka, 2011).

The temporary storage of the fruit depends on temperature and relative air moisture. The damage caused by very high or low temperatures results in tissue decomposition (Bălan et al., 2008).

MATERIALS AND METHODS

A wide range of 9 varieties was analysed: 'Danubiu', 'Ovidius', 'Favorit', 'Excelsior', 'Mamaia', 'Dacia', 'Orizont', 'Olimp' and 'Harcot', which are well-known in Romania.

The fruits were harvested from the orchard of the experimental area of the Faculty of Horticulture, in Bucharest.

We recorded the fruit bearing phases, the physical and chemical features of the fruits, defined when harvested as in-completely and fully maturated and at in-store maturity, weight, weight losses and quality drops throughout storage, with special reference to the attack of *Monilinia* sp.

The fruits were stored in the facilities of the laboratory existing at the Horticultural Faculty, being conducted in three variants, and each variant was repeated three times.

NA – normal atmosphere, namely storage in shed located in the orchard in a shady place and at an ambient temperature of 26°C.

CA – cold atmosphere, 2 to 3°C temperature and 78 to 83% relative humidity.
MA – modified atmosphere achieved by wrapping the storage case in plastic film at a temperature of 2 to 3°C.

RESULTS AND DISCUSSIONS

Physicochemical features of the fruits

Harvesting at wax ripening and at full maturity

By comparing the levels of some essential components of fruit quality we noticed an evolutive change in fruit size, in soluble dry matter content, overall sugar and ascorbic acid content (Table 1 and Table 2).
Higher gains were recorded in the 'Danubiu' variety: where the increase from wax ripening to full maturity was of 5% in soluble dry matter and the 'Favorit' variety recording 10.1% increase of soluble dry matter at the beginning of ripening and a fruit size of 59 g with an increase of up to 16% of soluble dry matter and a growth of up to 68.5g of the fruit; 'Excelsior' with a content 9.4% soluble dry matter at wax ripening and 14.6% at full maturity and 'Dacia', where the levels increased by 5% for soluble dry matter and by 15 g fruit weight.

Table 1. The main physical and chemical characteristics of the fruits of some apricot varieties as determined at picking in the wax-ripe phase

Variety	Average weight (g)	Total sugar (%)	Soluble dry matter (%)	Titratable acidity (%)	Total sugar/titratable acidity ratio	Ascorbic acid (mg/100 g)
'Danubiu'	55	7.2	9.0	2.21	3.26	7.04
'Ovidius'	50	9.44	11.8	2.30	4.10	5.28
'Favorit'	59	8.08	10.1	2.04	3.96	5.28
'Excelsior'	68	7.52	9.4	1.95	3.86	5.28
'Mamaia'	65	7.84	9.8	1.48	5.30	6.16
'Dacia'	52	9.12	11.4	2.05	4.45	5.28
'Orizont'	65	10.4	13.0	1.90	5.46	5.28
'Olimp'	73	8.8	11.0	1.61	5.46	4.4
'Harcot'	74	9.44	11.8	1.82	5.19	4.52

Table 2. The levels of some fruit quality in apricot varieties at full maturity

Variety	Average weight (g)	Soluble dry matter (%)	Total sugar (%)	Titratable acidity (%)	Total sugar/titratable acidity ratio	Ascorbic acid (mg/100 g)
'Danubiu'	57.5	14.0	12.3	2.02	6.1	16.19
'Ovidius'	53.7	13.0	10.0	2.20	4.5	11.50
'Favorit'	68.5	16.0	15.3	1.91	8.0	12.60
'Excelsior	70.6	14.6	13.0	1.67	7.8	11.62
'Mamaia'	67.8	13.0	10.3	1.22	8.4	11.52
'Dacia'	67.3	16.0	13.4	1.50	8.9	14.40
'Orizont'	68.5	15.0	12.3	1.32	9.3	12.02
'Olimp'	65.7	14.0	12.6	2.12	5.9	15.40
'Harcot'	67.2	15.0	12.8	1.40	6.4	13.80

Evolution of the main physicochemical features during in-store fruit maturity

The overall sugar content recorded by us increased irrespective of the storage variant or cultivar, except for Favorit, where a slight decrease under modified atmosphere conditions was recorded.

In the cold atmosphere variant at 2 to 3°C temperature and 78 to 83% relative humidity the increase in sugar content was lower than in the normal atmosphere, still higher than in the modified atmosphere (Table 3). Difference between varieties also occurred as far as the content of sugar during storage was concerned.

Table 3. The main chemical characteristics of the fruits of some apricot varieties as determined after storage period

Variety	Storage conditions	Soluble dry matter (%)	Total sugar (%)	Titratable acidity (%)	Total sugar/titratable acidity ratio	Ascorbic acid (mg/100 g)
'Danubiu'	NA	10.0	8.0	1.6	5.0	6.06
	CA	9.5	7.6	1.7	4.5	6.26
	MA	10.0	8.0	1.9	4.2	6.45
'Ovidius'	NA	12.5	10.0	1.6	6.2	4.25
	CA	12.0	9.6	1.8	5.3	4.65
	MA	12.0	9.6	2.0	4.8	4.80
'Favorit'	NA	14.4	11.5	1.6	7.2	4.05
	CA	14.2	11.4	1.8	6.3	4.35
	MA	10.0	8.0	1.9	4.2	4.57
'Excelsior'	NA	10.5	8.4	1.5	5.6	4.15
	CA	10.0	8.0	1.6	5.0	4.45
	MA	9.5	7.6	1.7	4.5	4.70
'Mamaia'	NA	12.0	9.6	1.3	7.4	5.16
	CA	12.5	10.0	1.4	7.1	5.46
	MA	13.0	10.4	1.5	7.4	5.70
'Dacia'	NA	15.2	12.2	1.5	8.1	4.00
	CA	15.0	12.0	1.6	7.5	4.20
	MA	1.,5	10.0	1.9	5.3	4.52
'Orizont'	NA	15.9	12.7	1.4	9.1	3.92
	CA	15.5	12.4	1.6	7.7	4.11
	MA	14.0	11.2	1.8	6.2	4.40
'Olimp'	NA	8	10.2	6.7	16.9	3.80
	CA	14	14.3	6.5	20.8	3.91
	MA	30	4.1	2.3	6.4	4.00
'Harcot'	NA	8	7.6	6.9	14.5	4.92
	CA	14	15.8	6.7	22.5	5.02
	MA	30	4.2	2.4	6.6	5.15

NA = Normal atmosphere; CA = Cold atmosphere; MA = Modified atmosphere.

In a normal atmosphere the highest rises were found in the 'Favorit' variety (by 3.4%), followed by 'Dacia' (3.08%), 'Harcot' (2.76%) and 'Orizont' (2.3%). In cold atmosphere the 'Favorit' variety recorded rises of 3.32%, 'Dacia' 2.28%, 'Harcot' 2.56% and 'Orizont' 2%. In modified atmosphere, the varieties 'Dacia', 'Orizont' and 'Olimp' showed increases of only 0.8%. A different behaviour was obvious with the 'Mamaia' variety, which recorded a 2.56% increase and the 'Favorit', where the sugar content drop correlated with the flesh browning was evident.

Titratable acidity also recorded different evolutions, depending on the variety and the storage method. Its lowest value was recorded in normal atmosphere, caused by the speeding up of oxidation at 26°C.

While at harvesting at wax ripening the titratable acidity limits ranged from 1.48% ('Mamaia') to 2.3% ('Ovidius'), in the normal atmosphere the limits ranged from 1.3% ('Mamaia') and 1.6% ('Ovidius'). In the cold atmosphere the limits were from 1.4% ('Mamaia') to 1.8% ('Ovidius' and 'Favorit'); while in the modified atmosphere the limits were from 1.5% ('Mamaia') to 2% ('Ovidius'). Storing in modified atmosphere caused a higher level of organic acids following the inhibitive effect of the CO_2 content increase into the dehydrogenase activity.

A decrease in the ascorbic acid content was between the beginning of the ripening and the post maturity stage in all the investigated varieties, with different intensities in each of the three storage variant.

The normal atmosphere variant recorded an ascorbic acid content as low as 3.8 mg/100 g ('Olimp') and 6.06 mg/100 g ('Danubiu'). Higher levels were recorded in the cold atmosphere variant, of 3.91 mg/100 g ('Olimp') and 6.26 mg/100g ('Danubiu'). The highest levels were recorded in the modified atmosphere variant ('Olimp' variety featuring 4 mg/100 g) and 'Danubiu' to 6.46 mg/100 g ascorbic acid. The value of the overall sugar/titratable acidity ratio that is a milestone for assessing the gustative quality of

horticultural products, encountered changes throughout the post-harvest period, following the unequal rate of these two components.
When harvesting at wax ripeness, this ratio ranged from 3.26 (‘Danubiu’) to 5.46 (‘Orizont’ and ‘Olimp’) going up to 5 (normal atmosphere variant), 4.5 (cold atmosphere) and 4.2 (modified atmosphere) for ‘Danubiu’ and to 9.1 (normal atmosphere), 7.7 (cold atmosphere) and 6.2 (modified atmosphere) for ‘Orizont’ while for ‘Olimp’ the results were 7.5 (normal atmosphere), 7.8 (cold atmosphere) and 6.4 (modified atmosphere). A higher value of the ratio under normal atmosphere conditions and a difference between the ratio in cold atmosphere and that in modified atmosphere were highlighted because modified atmosphere slows down the metabolism of organic acids and of glucides, which results in failing to attain the characteristic gustative features.

Capacity of temporary storage of apricot varieties

The duration of apricot fruits storage picked at the wax ripening phase differed in the three variants, as it is revealed in Table 4. Thus, the optimal storage duration in normal atmosphere was of 8 days, 14 days in cold atmosphere and 30 days in modified atmosphere. Overall losses (quantitative and qualitative) in fruits stored in normal atmosphere after 8 days were high because of the high temperature and low relative humidity, ranged from 14.5% in ‘Harcot’ variety and 26.7% in ‘Ovidius’ variety.
In the case of cold atmosphere, high overall losses were also encountered, ranging from 13.2% in ‘Orizont’ and 27.9% in ’Danubiu’, that is close to previous values (normal atmosphere), attained however after a 14 days’ laps of time. The overall losses after 30 days of storage under modified atmosphere were clearly lower than those in the two preceding variants. Thus, weight losses ranged from 1.5% (Excelsior) to 5.3% (‘Danubiu’). While the qualitative ones (*Monilinia* sp. attack or inner browning) ranged from 2.7% (‘Orizont’ and 14.5% ‘Favorit’). The ‘Favorit’ variety, as already mentioned, proves improved behaviour under these conditions, since fruits do not mature and the flesh becomes brown.

Table 4. Behaviour of the apricot fruits varieties harvested at wax ripeness

Variety	Storage conditions	Storage period (days)	Weight losses (%)	Quality losses (%)	Total losses (%)
‘Danubiu’	NA	8	9.8	10.5	20.3
	CA	14	21.4	6.5	27.9
	MA	30	5.3	3.4	8.7
‘Ovidius’	NA	8	14.4	12.3	26.7
	CA	14	20.2	6.8	27.0
	MA	30	5.2	3.1	8.3
‘Favorit’	NA	8	12.1	13.5	25.6
	CA	14	20.1	7.3	27.4
	MA	30	2.6	14.5	17.1
‘Excelsior’	NA	8	14.6	10.7	25.3
	CA	14	11.1	5.8	16.9
	MA	30	1.5	2.7	4.2
‘Mamaia’	NA	8	18.0	6.2	24.2
	CA	14	1.1	5.5	16.6
	MA	30	1.6	3.4	5.0
‘Dacia’	NA	8	13.4	7.5	2.,9
	CA	14	11.9	5.9	17.8
	MA	30	4.2	2.3	6.5
‘Orizont’	NA	8	9.0	6.3	15.3
	CA	14	7.5	5.7	13.2
	MA	30	3.1	1.7	4.8
‘Olimp’	NA	8	10.2	6.7	16.9
	CA	14	14.3	6.5	20.8
	MA	30	4.1	2.3	6.4
‘Harcot’	NA	8	7.6	6.9	14.5
	CA	14	1.8	6.7	22.5
	MA	30	4.2	2.4	6.6

CONCLUSIONS

In order to obtain highly qualitative fruits as far as the organoleptic aspect is concerned, after their temporarily storage under various conditions, fruits picked at wax ripeness period must feature values of the overall sugar/titratable acidity ratio of 3.26 to 5.46.

The optimal storage period for apricot fruits picked at wax ripeness stage was of 8 days in normal atmosphere, 14 days in cold atmosphere and 30 days in modified atmosphere.

The capacity of apricot fruits which were temporarily stored varied within close limits, the best results were recorded in 'Orizont', 'Olimp', 'Dacia' and 'Harcot' varieties.

The modified atmosphere obtained inside the storage package wrapped in semipermeable plastic film keeps the overall losses at a low value throughout the storage period, if compared to the normal atmosphere and cold atmosphere variants.

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