Scientific Papers. Series B, Horticulture. Vol. LX, 2016
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

STUDIES REGARDING THE INFLUENCE OF THE STORAGE CONDITION UPON THE SHELF LIFE OF SOME APPLE CULTIVARS

Adrian CHIRA[1], Lenuța CHIRA[1], Elena DELIAN,[1] Constanța ALEXE[2]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest,
59 Marasti Blvd, District 1, Bucharest, Romania
[2]Research and Development Institute for Processing and Marketing of the Horticultural products-Bucharest No.1A, Intrarea Binelui Street, District 4, Bucharest, Romania,
phone: 0770534388, fax 0214600725, email: tantialexe@yahoo.com

Corresponding author email: achira63@yahoo.com

Abstract

In this study, few aspects regarding the influence of different storage condition upon the shelf life of some apple cultivars were highlighted. In the experiment following apple cultivars were used: 'Redix', 'Rubinola' and 'Golden Delicious'. All fruits were harvested at the harvesting ripeness time. Afterwards, the apple fruits were stored in different environments, which consists the experimental variants: natural ventilation, cooling storage, cooling storage by using micro perforated bag pre-package and cooling storage by using semipermeable plastic bag package introduced into plastic material boxes. The obtained results show that the fruit storage period ranges from 80 days for 'Golden Delicious', 95 days for 'Redix' and 'Rubinola' in natural ventilation conditions to 130 days for 'Golden Delicious' and 140 days for 'Redix' and 'Rubinola', in conditions of refrigerating storage and fruit semipermeable plastic bags package. Regarding the rotting process, the main pathogens involved were Gloeosporium album for 'Golden Delicious' and Penicillium sp. for 'Rubinola'.

Key words*: shelf life, losses, semipermeable plastic bag.*

INTRODUCTION

One of the most important aspects of a product is its quality, both during trading and on reaching the consumer or final buyer. For non – perishable products, only the influence of production on quality is of any importance. During trade and distribution this quality will hardly change. If no calamities occur, these products remain in the same quality state during distribution.

For perishable products this picture changes compatibility. During trading and distribution up to the moment the product arrives at the final consumer, the quality may change quite rapidly, depending on the circumstances during storage and transport, thereby affecting both the possibilities of selling the product and the price that can be obtained (Viškelis P. et al., 2011).

For both types of product, perishable and non – perishable, the quality is of utmost importance (Ahmadi Afzadi M., 2012). In addition to the quality resulting from production, for the second type sufficient care should be taken to conserve quality during trade.

MATERIALS AND METHODS

The apple varieties 'Redix', 'Rubinola' and 'Golden Delicious' were harvested at the harvesting ripeness. At this moment, the main quality as physico-chemical properties were analyzed, afterwards apple fruits being stored in different conditions (Chira L. et al., 2014), which represent the experimental variants:

V1 = natural ventilation storage

V2 = refrigerating storage

V3 = refrigerating storage and micro perforated bag pre-package

V4 = refrigerating storage and semipermeable plastic bag package introduced into plastic material boxes.

The fruits have been weighed both before storage and at the end of the storage period. The fruit firmness was determined immediately after harvesting by using Effegi penetrometer.
The depreciation due to rottenness, the origin of main pathogen agents and the main fruit physic - chemical proprieties of the best variant was evaluated.

RESULTS AND DISCUSSIONS

As we can observe in Table 1, the storage period in natural ventilation conditions was shorter. The longest period was for V4, when the fruits were stored in a refrigerating storage and semipermeable plastic bags. In this way, a higher relative air humidity was ensured, a modified gaseous composition, enriched with CO_2 (5-6%) and rarefied on O_2. This environment preserved the fruit quality very well.
The losses of weight were greater at the fruits stored in natural ventilation storage conditions. This happened due to the higher temperature and the lower relative air humidity.
The least losses were registered at V4 as the fruit transpiration has been diminished.
We can point out rather similar values after loss of weigh at the three apple varieties, but the best results were registered for the 'Rubinola' cultivar. For Golden Delicious', the dropping was more significant than in the case of the other cultivars, because of the thin epidermal trait.
The depreciation due to rottenness and physiological disturbs presented higher values in V1 case, while in V4 we can find the lowest values. Different varieties registered different reactions. Thus for 'Golden Delicious', the percentage of rotten apples was of 16.2 %, after a 80 days storage period (V1) in comparison with 'Rubinola' – 11.4 % after a 95 days storage period (V1).
In the case of 'Golden Delicious', the presence of the pathogen agents that caused fruit depreciation was influenced by the storage as follows: the *Gleosporium album* has developed better in low temperature conditions and high relative humidity (V2, V3, V4) in comparison with V1. *Botrytis cinerea* has manifested itself stronger at a high temperature (V1). The physiological disturb (such as interval decay and fruit dehydration) was more significant in V1 as compared to V2, V3 and V4.
It has been observed that at the 'Rubinola' cultivar, in V4 the *Penicillium* sp. the attack was stronger. Actually, in all cases for 'Rubinola' the main pathogen agent involved was *Penicillium* sp.
The results achieved demonstrate the advantage of storing apples in a cooling environment, using micro perforated plastic bags and semipermeable plastic bags that can assure the best air humidity level and a modified gaseous composition, favorable for the apple fruits longer shelf life.
The quality of the apples was tested both during their harvesting and at the end of the storage period.

Table 1. The apple fruits shelf life and storage losses

Cultivar	Storage conditions	Storage duration (days)	Weight losses (%)	Rot losses (%)	Total losses (%)
'Redix'	V1	95	12.5	13.7	26.2
	V2	110	8.3	7.2	15.5
	V3	130	5.5	5.5	11.0
	V4	140	3.2	3.5	5.7
'Rubinola'	V1	95	10.2	11.4	21.6
	V2	110	7.5	9.3	16.8
	V3	130	5.0	7.8	12.8
	V4	140	2.5	5.5	8.0
'Golden Delicious'	V1	80	14.5	16.2	30.7
	V2	95	10.4	11.6	22.0
	V3	115	7.5	8.5	16.0
	V4	130	4.5	7.0	11.5

In the Table 2, only the results for the V4 variant are shown, which has proven to be the best – from the storage capacity point of view.

Regarding the average weight of the apples at harvesting, the 'Rubinola' cultivar was the biggest (180 g), 'Golden Delicious' weighted 175 g and 'Redix' 155 g. During the storage, these values diminished because of the transpiration water loss.

The fruit firmness determined immediately after harvesting by using Effegi penetrometer, registered the following values: Redix–6.4 kgf/cm^2, Rubinola–6.2 kgf/cm^2 and Golden Delicious–5.6 kgf/cm^2. These values decreased during the period due to pectin substance solubilization and to the transformation of the substances into soluble pectines under the action of the pectinmetilesterase enzyme. The values at the end of the storage period were: 'Redix'–4.8 kgf/cm^2, 'Rubinola'–5.8 kgf/cm^2 and 'Golden Delicious'–4.0 kgf/cm^2.

The soluble dry matter and the titratable total acidity were two biochemical indicators of great interest. The soluble dry matter content had the following values at harvesting: 'Redix'–11.8%, 'Rubinola'–11.2% and 'Golden delicious' 12.2%. The hydrolysis process of the starch and the accumulation of the soluble sugars continued during the storage period. Part of the carbohydrates served as an energetic basis in the respiration process during the storage period. At the end of the period, the values increased, arriving at 13.4% -'Redix', 12.8% -'Rubinola' and 13.8% -'Golden Delicious'.

The titratable total acidity expressed in malic acid values was as follows: at harvesting for 'Redix' –0.27%, for 'Rubinola' –0.24% and for 'Golden Delicious' –0.20%. At the end of the storage period, the values were lower, arriving at 0.18% to 'Redix', 0.17% to 'Rubinola' and 0,14% to 'Golden Delicious'.

The other analyzed biochemical components are also presented in the Table 2.

Table 2. The evolution of mainly fruit quality characteristics during storage

Cultivar	The moment of the analysis	Average Weight (g)	The firmness (kgf/cm^2	Water content (%)	Total dry matter (%)	Soluble dry matter (%)	Titratable acidity (% malic acid)	Ascorbic acid (mg/100g)	Mineral subst. (%)
'Redix'	At harvest	155	6.4	82.6	17.4	11.8	0.27	13.60	0.40
	After storage V4	150	4.8	80.0	20.0	13.4	0.18	11.35	0.34
'Rubinola'	At harvest	180	6.2	83.4	16.6	11.2	0.24	12.40	0.38
	After storage V4	175.5	5.8	81.4	19.6	12.8	0.17	10.80	0.32
'Golden Delicious'	At harvest	175	5.6	84.0	16.0	12.2	0.20	11.8	0.30
	After storage V4	167	4.0	81.2	18.8	13.8	0.14	10.2	0.24

CONCLUSIONS

The fruit storage period ranges from 80 days for 'Golden Delicious', 95 days for 'Redix' and 'Rubinola' in natural ventilation conditions to 130 days for 'Golden Delicious' variety and 140 days for 'Redix' and 'Rubinola', in conditions of refrigerating storage and fruit semipermeable plastic bags package.

The weight losses during the storage period were greater in natural ventilation conditions to 'Golden Delicious' cultivar – 14.5 %. The least losses of weight were registered in refrigerating storage environment by using semipermeable plastic bag package, at the 'Rubinola cultivar – 2.5%.

The main pathogen involved in rotteness was *Gloeosporium album* for 'Golden Delicious' and *Penicillium* sp. for 'Rubinola'.

During the storage period, the fruit water content decreased and there was a higher soluble carbohydrate content, a diminishing of fruits weight as a consequence of water losses, and a decrease of fruit firmness because of the pectin's enzymatic breakdown.

REFERENCES

Ahmadi Afzadi M., 2012. Genetic and biochemical properties of apples that affect storability and nutritional value. Introductory paper at the Faculty of Landscape Planning, Horticulture and Agricultural Science – 1, Balsgard, Sweden, 1-41.

Chira L., Chira A., Delian E., Alexe C., Marin L. 2014, Research Concerning the Influence of Different Storage Conditions on the Preservation Capacity of Some New Apple Varieties. Scientific Papers. Series B, Horticulture, Volume LVIII, Print ISSN 2285-5653, 29-32.

Viškelis P., Rubinskienė M., Sasnauskas A, Bobinas C., Kviklienė N., 2011. Changes in apple fruit quality during a modified atmosphere storage. Journal of Fruit and Ornamental Plant Research Vol. 19: 155-165.