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RESEARCH CONCERNING THE INFLUENCE OF DIFFERENT STORAGE CONDITIONS ON THE PRESERVATION CAPACITY OF SOME NEW APPLE VARIETIES

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Abstract

The preservation of apples for a longer period in order to assure the extension of the scope of the consumption as fresh fruit represents a major scope of the producer and merchandiser, which produce end export such fruits. The research performed in this field with the apple varieties 'Luna', 'Redix', 'Jonaprim', 'Goldrush', 'Florina', 'Rubinola' and 'Sirius', stored in different storage conditions, emphasized the difference between cultivars because of the different time of maturation. In the case of the same cultivar, the time of preservation was shorter in the ambient conditions (60 days for 'Sirius'), reaching 120 days in the modified atmosphere condition, under refrigeration. 'Florina' and 'Redix' were preserved for 90 days in the ambient condition and for 140 days in the modified atmosphere, under pre-refrigeration. The weight losses were lower for all cultivars in modified atmosphere (3,8% for 'Florina', 4,2% for 'Redix' and 4,6% for 'Sirius'). At the beginning of the storage period, and at the end of the preservation period, the main physico-chemical characteristics were also analyzed. The obtained results show that 'Florina' and 'Jonaprim' were the best, for example regarding the firmness values, at the end of the storage period.

Key words: *capacity, conditions, maturation, preservation, varieties*

INTRODUCTION

Specialists of producing and exporting apples countries have focused their attention on the long period apple storage problem, so that the apple could be sold, consumed in a staggered way.
The apple storage duration and the apple storage economic efficiencies are eventually determined by the loss of weight value by the depreciation due to rottenness (Chira L. et al., 2003).

MATERIALS AND METHODS

The research material was represented from seven new apple cultivars: 'Luna', 'Redix', 'Jonaprim', 'Goldrush', 'Florina', 'Rubinola' and 'Sirius', cultivated in Fruit Research Center of USAMV Bucharest.
The fruits were harvested at the harvesting ripeness time, when the main qualitative properties were analysed, afterwards, apple were stored in different storage conditions (Chira A., et al., 2002) which represent the experimental variants:
V1-ambient conditions; T=20°C; U.R.=65%
V2-refrigerating conditions; T=2°C; U.R=75%
V3-refrigerating storage and modified atmosphere (T=2°C, U.R.=90%).
The apple have been weight both when they were introduced for store and at the end of storage period, so that specialists could find out the differences of weight. At the same time, at the end of the storage period, the depreciation due to rottenness, the origin main pathogen agents and the main fruit physic-chemical and organoleptic properties of the best variant were evaluated.

RESULTS AND DISCUSSIONS

As we can see in the table 1, the ambient storage period conditions was shorter. The

longer period was for V3. The fruits were stored in a refrigerating space and semi permeable plastic bags. In this way, it was ensured a higher relative air humidity, a modified gaseous composition, enriched with CO_2 (5-6%) and rarefied of O2.
These conditions preserved the fruits very good.
The losses of weight was grater at the fruits stored in ambient storage conditions. This happened due to the higher temperature and to the lower relative air humidity.
The least losses were registered at V3 – as the fruit transpiration has been diminished.

Table 1. The storage capacity of the apple fruits

Variety	Storage condition	Optimal storage period -days-	Weight Losses -%-	Rot Losses -%-	Total Losses -%-
LUNA	V1	70	6,2	9,0	15,2
	V2	100	4,4	6,2	10,6
	V3	120	3,6	4,0	7,6
REDIX	V1	90	6,8	7,6	16,4
	V2	120	4,8	5,4	10,2
	V3	140	4,2	3,8	8,0
JONAPRIM	V1	70	6,6	8,4	15,0
	V2	90	5,2	6,2	11,4
	V3	110	4,0	4,8	8,8
GOLDRUSH	V1	90	6,2	10,2	16,4
	V2	110	5,4	7,4	12,8
	V3	130	4,8	4,6	9,4
FLORINA	V1	90	5,8	6,8	12,6
	V2	120	4,0	5,0	9,0
	V3	140	3,8	3,2	7,0
RUBINOLA	V1	90	5,6	10,0	15,6
	V2	120	4,8	8,2	13,0
	V3	140	4,4	5,8	10,2
SIRIUS	V1	60	6,0	8,2	14,2
	V2	90	5,2	6,8	12,0
	V3	120	4,6	4,0	8,6

V2 – Ambient condition (T= 20°C, U.R. = 65%)
V2 – Refrigeration condition (T = 2°C, U.R. = 75%)
V3 – Modified atmosphere under refrigeration (T = 2°C, U.R. = 90%)

We can point out rather similar values after loss of weight at the seven tested apple cultivars, but the best results were registered for 'Goldrush'. The problem in the dropping is more significant that other cultivars, because of the thin epidermal skin.
The depreciation due to rottenness and physiological disturbs presented higher values in V1 case, while in V3 we can find the lowest values. Different cultivars registered different reaction. Thus, for 'Goldrush', the percentage of rotten apples was of 10,2% after a 90 days storage period (V1) in comparison with 'Florina' – 6,8% after 90 days storage period (V1).
In 'Goldrush' case, the presence of the pathogen agents that caused fruit depreciation has been influenced by the storage as follows: the *Gloeosporium album* has developed better in low temperature conditions and high relative humidity (V2, V3) in comparison with V1. *Botrytis cinerea* has manifested itself stronger at a high temperature (V1).
It has been observed that the 'Jonaprim', in V3, the *Penicillium sp*. attack was stronger.
Actually, in all cases for 'Jonaprim', the main attacking pathogenic agent was *Penicillium sp.*
The quality of the apples has been tested both during their harvesting period and at the end of the storage period.
In table 2 we show the results only for V3. This variant has proved to be the best – from the storage capacity point of view.
Regarding the average weight of the apples at harvesting, 'Sirius' was the biggest (250,7 g). 'Redix' weighted 184 g and 'Rubinola' 150 g. During the storage period, these values diminished because of the water loss by transpiration.
The firmness determined immediately after harvesting by Effegi penetrometer has the following values: 'Florina' – 6,4 kgf/cm^2 and 'Goldrush' - 5,6, kgf/cm^2.
These values decreased during the period due to pectin substance solubilisation and to the transformation of the substances into soluble pectin because of the pectinmetilesteraze enzyme. The values (at the end of storage period) were between 5,2 – 'Florina' and 4 kgf/cm^2 to 'Goldrush'. The soluble dry substance content and the titratable total acidity were two biochemical indicators of great interest. The soluble dry substance content had the following harvesting values: 'Goldrush' – 15,9 % and 'Florina' – 13,7%.
The soluble sugars value evaluation is as follows: at harvesting the content was between 12% at 'Sirius' and 15,9 at 'Jonaprim' and 'Goldrush'.
The hydrolysis process of the starch and the accumulation of the soluble sugars continued during the storage period. At the end of the period, the values increased till 13,8% to 'Sirius' and 16,8% to 'Goldrush'.
The titratable total acidity expressed in malic acid values is as follows: 'Jonaprim' – 0,40% (at harvesting) – 0,3% (end storage period) and

'Sirius' – 0,3% (at harvesting) and 0,18% (at the end of storage period).
The other analysed biochemical components are also shown in table 2.
This show us the advantage of storing apples in refrigerating storage using semipermeable plastic bags that can assure the best humidity conditions and a modified gaseous composition, favourable for fruit storage.

Table 2. The evolution of the mainly qualitative characteristics during apple storage period

Variety	The analysis period	Firmness Kgf/cm2	Water content -%-	Total dry Matter -%-	Soluble dry Matter -%-	Titerable acidity -%- acid malic	Ascorbic acid (mg/100g)
LUNA	At harvest	6,0	82,6	17,4	14,1	0,31	12,65
	V3- end storage	4,6	79,4	20,6	15,4	0,24	11,20
REDIX	At harvest	6,2	82,4	17,6	14,5	0,35	11,40
	V3- end storage	4,4	79,0	21,0	15,6	0,24	10,60
JONAPRIM	At harvest	5,8	83,0	17,0	15,9	0,40	12,80
	V3- end storage	5,0	79,7	20,3	16,6	0,30	11,40
GOLDRUSH	At harvest	5,6	83,2	16,8	15,9	0,26	12,20
	V3- end storage	4,0	79,2	20,8	16,8	0,20	10,80
FLORINA	At harvest	6,4	82,6	17,4	13,7	0,35	12,65
	V3- end storage	5,2	79,3	20,7	15,0	0,28	11,10
RUBINOLA	At harvest	6,0	83,0	17,0	15,0	0,30	11,80
	V3- end storage	4,8	79,3	20,7	15,8	0,20	10,60
SIRIUS	At harvest	6,2	82,8	17,2	12,0	0,30	12,40
	V3- end storage	4,8	79,0	21,0	13,8	0,18	11,00

CONCLUSIONS

The fruits storage period ranges from 60 days for 'Sirius' (in ambient conditions) to 140 days for 'Florina' and 'Redix' (in refrigeration under modified atmosphere).
The loss of weight during the storage period were greater in ambient conditions (16,4% 'Redix' and 'Goldrush') and lower in refrigeration modified atmosphere (7% to 'Florina' and 8% to 'Redix').
The main microbiological pathogens developed during storage period were *Gloeosporium album* for 'Goldrush' and *Penicillium sp*. for 'Jonaprim'.

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