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ASPECTS REGARDING THE STORAGE BEHAVIOUR OF SOME APPLE VARIETIES WHICH ARE MORE OR LESS KNOWN IN ROMANIA

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Abstract

The consumption of fresh apples has been and still is recommended by nutritionists, in favour of frozen, dehydrated or heat processed fruit. In the current study, we intend to present the evolution of the main physical and chemical components with nutritional value of some apple varieties, cultivated in both Europe and Romania. 6 varieties have been observed, namely: Redix, Goldrush, Florina, Generos, Topaz and Enterprise. Biometric measurements have been carried out, as well as the organoleptic assessment and physio-chemical tests: pulp firmness, soluble dry matter, titratable acidity and the content of Ascorbic acid (Vitamin C). The analysis had two storage variants: V1.Cooling Room, at T = 4 ^{0}C and RH =85%.; and V II. Traditional Cellar with T = 12-15 ^{0}C and RH = 70 - 75%. In both storage conditions, after 90 days the Enterprise variety has excelled, receiving the highest score in the organoleptic assessment and has also had higher S.D.M. and Vitamin C quantities in comparison with the other varieties put under observation.

Key words**:** *firmness, rottenness, storage condition, soluble dry matter*

INTRODUCTION

Apples have played an important role in humankind's nutrition since ancient times. Furthermore, all consumers know their importance in the daily food intake through the beneficial contribution to general wellness [2][4][5]. The consumption of fresh apples has been and still is recommended by nutritionists, in favour of frozen, dehydrated or heat processed fruit.

Even if the globalisation of food commerce has reached our country as well, one should not disregard the wish of the consumer, nostalgic as he might be, to eat local products and apples that were cultivated in Romania.

Modern technologies have enabled the storage of apples for longer periods of time, depending on the storage method [6].

In the current study, we intend to present the evolution of the main physical and chemical components with nutritional value of some apple varieties cultivated in Romania, which are more or less known to the ordinary consumers, by using two storage methods.

MATERIALS AND METHODS

The apples used for our research were harvested from the experimental orchard of the Horticultural Faculty within USAMV Bucharest, grown in pedo-climatic conditions specific to the Bucharest area in the year 2018. It has to be mentioned that this year, most of the fruit trees, especially the apple trees, were overloaded with fruit.

The varieties taken under observation were: Redix, Goldrush, Florina, Generos, Topaz and Enterprise. These are all winter apple varieties, which have good storage capacity.

This year no thinning activities were carried out in the orchard and for more than any other variety that was studied, the Goldrush variety was overloaded with fruits, which were small and had high pulp firmness.

The harvesting of the apples was performed at ripeness, in the second decade of September, when the outside temperature was 23 ^{0}C.

After weighing, the apples were put into storage in 2 variants as follows:

V1 = CR Cooling Room) at T = 4 ^{0}C and RH = 85%.
V2 =TC (Traditional Cellar) at T = 12-15^{0}C and RH = 70 -75%.
Biometric measurements and physio-chemical tests have been carried out: pulp firmness (using the Effegi penetrometer), Soluble Dry Matter (S.D.M.), titratable acidity in malic acid and the content of Ascorbic acid (Vitamin C).
The organoleptic assessment, at the end of the storage period was also an indicator that we analysed in our research.

RESULTS AND DISCUSSIONS

The results of the research are displayed in the tables which follow, and the data obtained represents the average, resulted from the values of the fruit which were analysed.
The physical changes studied highlight the loss in weight and the loss through fruit rotting, as well as the evolution of the pulp firmness during storage. The firmness was measured with a penetrometer and expressed in kgf/cm^2.

Table 1. Biometric measurements of the apples

Variety	Average weight /unit (g)	Fruit height (mm)	Fruit diameter (mm)	Shape index
REDIX	140.14	6.2	5.9	1.05
GOLDRUSH	83.13	4.3	4.9	0.88
FLORINA	162.10	5.6	5.4	1.03
GENEROS	180.00	5.6	7.1	0.80
TOPAZ	130.00	4.8	6.8	0.70
ENTERPRISE	185.00	5.5	6.8	0.80

Source: Own determination.

Table 2. Losses during storage (90 days) in the Cooling Room

Variety	Initial firmness (kgf/cm^2)	Final firmness (kgf/cm^2)	Weight losses (%)	Rottenness losses (%)	Total losses (%)	Organoleptic assessment (points)
REDIX	6.4	5.5	2.15	7.02	9.17	19.66
GOLDRUSH	7.9	6.5	2.72	5.20	7.92	27.33
FLORINA	7.1	4.5	1.43	10.12	11.55	23.66
GENEROS	6.2	3.9	1.45	10.00	11.45	28.00
TOPAZ	5.6	4.7	1.65	15.30	16.95	26.66
ENTERPRISE	6.9	6.2	1.63	20.15	21.78	30.66

Source: Own determination.

Table 3. Losses during storage (90 days) in Traditional Cellar

Variety	Initial firmness (kgf/cm^2)	Final firmness (kgf/cm^2)	Weight losses (%)	Rottenness losses (%)	Total losses (%)	Organoleptic assessment (points)
REDIX	6.4	4.0	4.01	10.20	14.21	25.00
GOLDRUSH	7.9	6.2	4.02	5.14	9.16	22.33
FLORINA	7.1	3.7	3.73	15.02	18.75	20.33
GENEROS	6.2	3.5	5.35	25.00	30.35	20.33
TOPAZ	5.6	4.2	3.68	17.45	21.13	19.00
ENTERPRISE	6.9	5.1	3.95	22.25	26.20	28.00

Source: Own determination.

The overall losses were recorded due to the weight losses and to diseases and physiological disorders which were manifested during storage [7]. The most losses were recorded for the Generos variety – 30.35%, which was kept in Traditional Cellar, in comparison with 11.45%, in cooling conditions (Cooling Room). The least number of losses could be observed for the Goldrush variety – 7.92% in CR and respectively 9.16% in TC.

Table 4. The main chemical characteristics of the fruits of some apple varieties in the Cooling Room

Variety	Soluble dry matter (%) initial	Soluble dry matter (%) final	Titratable acidity (%) initial	Titratable acidity (%) final	Ascorbic acid (mg/100g) initial	Ascorbic acid (mg/100g) final
REDIX	12.7	14.1	0.37	0.35	3.88	2.58
GOLDRUSH	12.4	14.8	0.48	0.45	8.28	6.65
FLORINA	13.3	13.9	0.24	0.21	6.52	5.95
GENEROS	11.2	13.1	0.40	0.40	6.76	5.05
TOPAZ	13.4	15.4	0.80	0.78	5.45	4.25
ENTERPRISE	15.3	16.6	0.72	0.71	3.44	2.64

Source: Own determination.

Table 5. The main chemical characteristics of the fruits of some apple varieties during storage in Traditional Cellar

Variety	Soluble dry matter (%) initial	Soluble dry matter (%) final	Titratable acidity (%) initial	Titratable acidity (%) final	Ascorbic acid (mg/100g) initial	Ascorbic acid (mg/100g) final
REDIX	12.7	14.7	0.37	0.34	3.88	2.05
GOLDRUSH	12.4	15.2	0.48	0.39	8.28	5.90
FLORINA	13.3	15.3	0.24	0.19	6.52	4.20
GENEROS	11.2	13.9	0.40	0.37	6.76	4.16
TOPAZ	13.4	15.8	0.80	0.75	5.45	4.20
ENTERPRISE	15.3	16.8	0.72	0.69	3.44	2.02

Source: Own determination.

As expected, the total losses were higher for all the varieties stored in the traditional way, in comparison with the Cooling Room alternative.

The firmness of the apples represents a quality guarantee during handling, transport and marketing. [3][4].

According to previous sources in the literature, bigger fruits have lower firmness than smaller fruits, because smaller fruits have more matter gathered in the cell walls per volume unity and should; therefore, have firmer tissues than bigger fruits [8].

This is the explanation for the higher values recorded in our research for the Goldrush variety, for which the average weight per fruit was 83.13g, in comparison with the other varieties that were analysed. The initial firmness was 7.9 kgf/cm^2 and during storage decreased to 6.5 kgf/cm^2 in CR and 6.2 kgf/cm^2 in TC.

The organoleptic assessment of the fruits stored in CR revealed the following score: the Enterprise variety – 30.66 marks as being the most appreciated and Redix – 19.66 as being the weakest as far as organoleptic parameters are taken into consideration.

After a period of 90 days of storage, small relative differences are detected with regard to the score obtained, regardless of the storage conditions. An exception to this is the Redix and Topaz varieties.

In TC, the variety most valued by consumers was Enterprise, with 28.88 marks, and the least valued was Topaz, with 19 marks.

As shown in tables 4 and 5, the chemical changes of the main components analysed record significant quantitative variation. The soluble dry matter increased during storage for all varieties in comparison with the starting point, owing to the transformation of starch into soluble carbohydrates. The highest scores were recorded for Enterprise, 16.6% (CR) respectively 16.8% (TC), followed by Topaz with 15.4 (CR) and 15.8% (TC).

The total titratable acidity decreased in quantity during storage irrespective of the storage conditions [3]. The values were between 0.24% (Florina) and 0.80% (Topaz), at the beginning of their storage, decreasing to 0.19% (Florina) and 0.69% (Enterprise). Ascorbic acid (Vitamin C) decreases during storage, both in refrigerate conditions and in the traditional alternative. This decrease is correlated to the decrease of the total titratable acidity, since it is known from previous sources in the literature that this vitamin is stored well only in acid environments [1].

After 90 days of storage, the highest quantity of ascorbic acid was detected in the Goldrush variety – 6.65mg/100g in CR respectively 5.9 mg/100g in TC.

CONCLUSIONS

The losses recorded during storage differ according to both the storage conditions and the variety. The varieties which did the best in both storage conditions were Goldrush and Redix.

The organoleptic assessment shows that the Enterprise variety had the best qualities in the climatic conditions of the year 2018, with a total of 30.66 marks in CR and 28.00 marks in TC, after 90 days of storage.

The content of S.D.M. was the highest for the Enterprise variety – 16.6% in CR and 16. 8% in TC. The high S.D.M. levels, together with the high level of acidity determined the choice of the Enterprise as the best among the varieties taken under observation.

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