

## RESEARCHES ON QUALITATIVE AND QUANTITATIVE ANALYSIS, ON DURATION OF STORAGE IN VARIOUS VARIETIES OF APPLES

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### Abstract

*The research was made in an organic farm, located on a preluvosol soil type with pedoclimatic conditions that support the apple plantations in this area. In this paper, the aim was to establish the capacity to store the fresh fruit quality and to highlight the diseases of the storehouse, of the varieties existing in the grown variety. Six varieties of homologated varieties of apple (Florina, Generos, Golden Delicious, Idared, Jonathan and Redix) were taken into consideration in order to establish the ability to store the apple quality in fresh state. It was found that the lowest total loss, with values below 10%, was registered at V3-Idared (7.45%). This variant presented both low weight losses and depreciation due to disease attack. The same variety also retained its initial firmness with an insignificant difference during storage. At the same time, it was noted that the highest content of initial juice extracted, belongs to V3-Idared and V4-Florina variants with more than 600 ml/kg.*

*Key words:* apples, quality, storage, depreciation, firmness, varieties, juice.

### INTRODUCTION

The quality concept for fruit is a complex and current notion, which can be analyzed under the following aspects: organoleptic, commercial, nutritional agronomic and sanitary [15], [1].

Fresh fruit supply is an aspect of great importance, due to the growing demands of horticultural products by the consumers.

The high nutritional value of fruit, especially apples, and the long period of time that they can cover, cause high consumption among the population [6].

According to the state of the products and methods used, the fruits are recovered in a fresh state and in processed state (totally or partially) [4], [10]. The contribution of apples for consume is higher when they are consumed in the fresh state [6], as a consequence, maintaining unchanged food value is an important problem of using [11], [3]. Apples are some of the fruits that if they are properly stored can cover consumption throughout the year [2]. In order to keep their food value and commercial aspect, the storage conditions are of the highest importance [14].

Following the process of fresh unfermented fresh products pressing, some of the apple production is transformed into fruit juice [13], [12]. A special interest in the preparation of juices is the retention in the finished product of all the nutritional and taste qualities of the fruits [8], [16].

### MATERIALS AND METHODS

In order to establish the capacity of keeping the apples quality in fresh state, six homologated varieties of apples were taken into consideration in the study: Florina, Generos, Golden Delicious, Idared, Jonathan and Redix. The apples were stored and preserved in plastic boxes, in cold conditions with controlled atmosphere.

After 150 days of storage determinations were made related to:

- the level of quantitative and qualitative losses;
- changing fruit consistency (firmness);
- fruit juice content;

The experiments were organized in 6 comparative variants, of 3 repetitions for each variant. During storage, daily control of the

thermo-hydro factors in the refrigeration room was performed in order to ensure that the optimal conditions for quality maintaining were observed.

During storage, the apple quality maintenance capacity was assessed, with findings on aspect changes related to dehydration and the occurrence and evolution of various storage diseases [9].

After the removal of the apples from the storage space, determinations were made regarding the level of the quantitative and qualitative losses registered by the fruits, the change of the firmness of the fruit (determined by penetrometry), the determination of the changes in the juice content.

The determination of weight losses by spoiling during the retention period was done by weighing the resulting fruit samples, respectively the spoiled, rotten (diseased) fruit compared to the initial stored quantities, the results being expressed as a percentage.

The determination of the pulp juice content was made at a number of 25 fruits of each variant. The juice extraction was made by means of a centrifugal laboratory juicer, the amount of juice extracted being related to the pulp weight of the fruits introduced in the juice extraction process and expressed in ml/kg and g/kg.

The fruit firmness was determined with a manual penetrometer, Effe-gi type, with large

piston with 11 mm diameter, at a number of 25 fruits per variant, each fruit being penetrated in 4 points in the equatorial area after removing the epidermis in the penetration areas.

## RESULTS AND DISCUSSIONS

The researches made, aimed to establish the capacity of maintaining the fruit quality in fresh state, the apples firmness when storing in storehouse and the evolution of the changes in the apple juice content during storage.

### Evolution of fruit firmness during storage

In Table 1, data on the firmness of apples during storage is shown, so it is found out that when refrigerated storage, the studied apple varieties showed a different degree of pulp consistency. The highest firmness was determined at V4-Florina (6.40 kgf/cm<sup>2</sup>), and the lowest at V1-Jonathan (3.38 kgf/cm<sup>2</sup>).

The average of the 6 variants was 4.17 kgf/cm<sup>2</sup>. During storage, the firmness of apples decreased to most variants in different percentages ranging between 3.89 kgf/cm<sup>2</sup> (V5-Redix) which registered the lowest firmness and 4.62 kgf/cm<sup>2</sup> at V6- Golden Delicious, with the best firmness. Variety V1-Jonathan showed increase of 15.50% after the storage period, the firmness of the fruit being of 4.00 kgf/cm<sup>2</sup>.

Table 1. Apples firmness during storage and after storage

Variant	Variety	Penetration value (kgf/cm <sup>2</sup> )		Differences	
		On storage	After storage	Kgf/ cm <sup>2</sup>	%
V1	Jonathan	3.38	4.00	+0.62	+15.50
V2	Generos	4.79	3.91	-0.88	-22.50
V3	Idared	4.46	4.38	-0.08	-1.82
V4	Florina	6.40	5.21	-1.19	-22.84
V5	Redix	4.50	3.89	-0.61	-15.68
V6	Golden delicious	4.87	4.62	-0.25	-5.41
<b>Average</b>		<b>4.17</b>	<b>4.35</b>	<b>-1.19</b>	<b>-8.79</b>

Source: Own determinations

The fruit firmness at the end of the storage period was contained between 3.89 kgf/cm<sup>2</sup> (V5-Redix) and 5.21 kgf/cm<sup>2</sup> (V4-Florina), with an average of the 6 variants of 4.35

kgf/cm<sup>2</sup>, value with 8.79% more reduced than the initial one.

From all variants, V3-Idared maintains the same firmness of the fruit during their storage,

the difference of fruit storage being insignificant.

**Changes in the content of apple juice during storage.**

The initial content of apple juice extract is contained, according to volume, between 549-630 ml/kg, and the juice weight, between 609-680 g/kg.

The apples with the highest initial juice extract content belong to the V3-Idared and V4-Florina variants, with over 600 ml/kg. The lowest juice content was registered with V2-Generos (549 ml/kg).

During storage, the apple juice content changed, volumetrically, increasing on average by 8.08% and the weight by 6.40%, existing also the V6-Golden delicious variant, where the juice content showed a decrease of 7.94% (Table 2).

Table 2. Volume of apple juice per extraction before and after storage, related to the pulp

Vari-ant	Variety	Volume (ml/kg)		
		Initial	final	dif. (%)
V1	Jonathan	573	641	+10.60
V2	Generos	549	660	+16.81
V3	Idared	630	680	+7.35
V4	Florina	612	666	+8.10
V5	Redix	580	671	+13.56
V6	Golden delicious	571	529	-7.94
<b>Average</b>		<b>586</b>	<b>641.16</b>	<b>+8.08</b>

Source: Own determinations

Table 3. Weight of apple juice on extraction before and after storage, related to pulp (net)

Vari-ant	Variety	Weight (g/kg)		
		Initial	final	dif. (%)
V1	Jonathan	618	652	+5.21
V2	Generos	609	679	+11.12
V3	Idared	680	707	+4.12
V4	Florina	655	673	+2.90
V5	Redix	611	678	+11.33
V6	Golden delicious	638	664	+3.75
<b>Average</b>		<b>635.16</b>	<b>675.5</b>	<b>+6.40</b>

Source: Own determinations

Table 3, shows the weight loss of the apple juice during storage, where the largest losses are in V5 - Redix variety (11.33%), losses related to the volume, followed by losses from

the variety V2 - Generous, with a difference of 11.12%, from the initial moment of storage.

**Qualitative and quantitative losses, registered at fruits during storage, at the 6 variants.**

From the data shown in table 4, it results that in apples, the total losses during storage are contained between 6.89 % - 80.12 %, with an average of 34.55 %. The weight losses range between 4.05–10.76 %, with an average of 7.67%, and the spoiled ones between 3.33–69.87%, with an average 27.49 %.

Table 4. Losses registered during apple storage

Vari-ant	Variety	Losses (%)		
		Total	Weight	Spoiling
V1	Jonathan	35.11	5.59	28.07
V2	Generos	19.92	10.01	10.85
V3	Idared	6.89	4.05	3.33
V4	Florina	15.28	6.88	8.95
V5	Redix	50.02	8.73	43.91
V6	Golden delicious	80.12	10.76	69.87
<b>Average</b>		<b>34.55</b>	<b>7.67</b>	<b>27.49</b>

Source: Own determinations

The lowest total losses, with values under 10% are registered at V3-Idared (6.89%), this variant shows both low losses and depreciations due to the diseases attack.

V6-Golden delicious variant shows the largest total loss by spoiling (80.12%), research with similar losses was reported and confirmed by other researchers [7].

The lowest weight losses were determined for V3-Idared fruit (3.33%), and the highest weight losses were registered at V6-Golden delicious and V2-Generos (10.76%), compared to the average of 7.67%. The apple variety that registered the lowest loss is Idared, and the least resistant to the storage was Golden delicious variety.

Losses on the whole by spoiling shown a high level with an average of 27.49%. The lowest loss by spoiling, with values below 10%, was determined at V3-Idared, followed by V4-Florina (8.95%), concluding that these two varieties: Idared and Florina, are the most resistant to spoiling.

The highest losses by spoiling were determined at V6-Golden delicious (69.87%), percent that increased three times compared to the spoiling average of these 6 varieties (27% 49%). And

V5 – Redix variant shows spoiling conditions quite frequent, compared to the average.

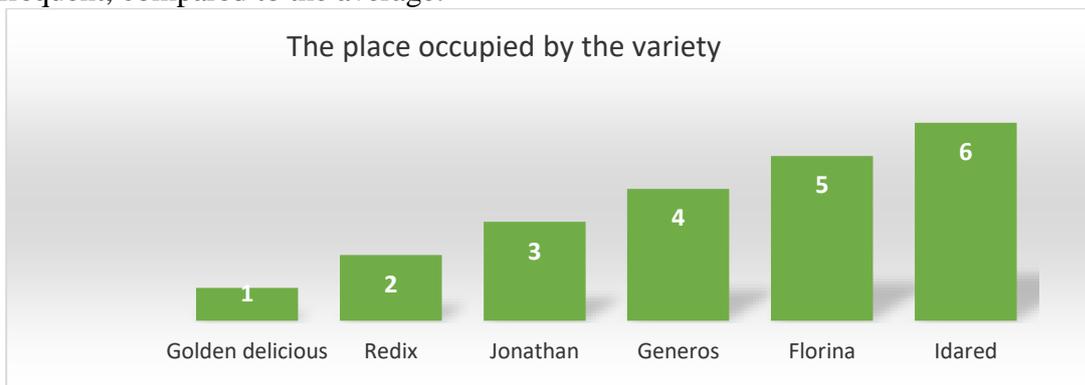


Fig. 1. The place occupied of each variety, depending on the losses registered during the apple storage  
Source: Own determinations

## CONCLUSIONS

The presented conclusions refer to the results obtained following the experiments made on the fruit in the harvest of 2015-2016, with the specific climatic conditions of this period.

In apples, total losses during storage were between 6.89 to V3 - Idared and 80.12% to V6 - Golden delicious, with an average loss of 34.55%.

The weight losses were between 4.05 (Idared) and 10.76% (Golden delicious), with an average of 7.67%, and the losses by spoiling were between 3.33 - 69.87%, at the same varieties, with an average of 27.49%.

Idared and Florina varieties showed a low total loss due to the low level of weight losses and depreciation during storage. Very large losses were registered in the Golden delicious and Redix varieties, with a high level of depreciation.

The firmness of apples decreased to most variants during refrigeration with values ranging between 3.38 Kgf/cm<sup>2</sup> (Jonatan) and 6.40 Kgf/cm<sup>2</sup> (Florina), while existing apples that retained their initial firmness almost unchanged, such as Idared variety, with a modified firmness of up to 1.82%.

Among all varieties, it was noted that Idared variety retained its initial firmness with an insignificant difference during storage (0.08%) and Golden delicious variety which had the lowest decrease in firmness.

The apple initial juice content is the highest over 600ml/kg, belonging to Idared and Florina

varieties, and the lowest values were registered in Generos variety. During storage, the tendency was a slight increase in the juice content (on an average by 8.08% volumetrically and by 6.40% weight), compared to the initial values registered on storage.

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