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Research regarding influence of some postharvest change on plums quality

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Abstract The objectives of this research were to determine the biometrics and biochemical changes of plum fruits in the main indices during postharvest processes.

Stanley, Santa Rosa, Ciruela Fortuna, Flavor King (Greece), Record, Tuleu Gras and Bistrite (Romania) were the cultivars of plum who were represented the biological material. During the experiment were studied the following parameters: fruit juice acidity, fruit's dimensions (fruit length, diameter, weight), firmness, dry matter and soluble carbohydrate content. The biological material was storage for 7 and 14 days at 4 ^{0}C and 25 ^{0}C.

Due to post-maturation processes, after 14 days of storage, specially respiration (degradation of the organic substrate), there was a reduction of the diameter, the length and weight of the plum. After 7 days of conservation, regarding the biochemical characteristics, it can be see there is an increase of soluble carbohydrate content, while the firmness and acidity of the fruit juice decreased.

After 14 days of conservation in case of biochemical parameters, after enzymatic hydrolysis processes there is an uniterrupted trend to increase the soluble carbohydrate content due to conversion of starch into glucose and but also a slight decrease of the fruit juice acidity. During preservation, experiments have shown that plum genotypes tested had an increase in dry matter content.

Key words

postharvest, plum, firmness, acidity, dry matter

Plums are part of the Rosaceae family and include 'Japanese plums', belonging to the species Prunus salicina Lindell, which is native to China, and 400 years ago was domesticated in Japan; and 'European plums', belonging to the species Prunus domestica L., with a long history of cultivation, especially in Europe are believed to have originated in the Near East. [3].

Fruit maturation is a complex of chemical reactions that transforms the complex chemical components into simple chemical. As a result of the biochemical changes occurring at the beginning of the baking process and continuing in the maturation phase, the fruits acquire new properties that improve their taste, aroma, succulence and color [6].

As a climacteric fruit, during development, the plum showing a peak in ethylene production and respiration. Nevertheless, several cultivars have been observed two distinct types of ripening behaviour, those showing: a typical climacteric behaviour and considered suppressed climacteric. The latter group showed a low ethylene production until late stages of development, which is thought to be insufficient to coordinate ripening [1,2,14,17].

Until in our days it's far from being understood, the physiological control of plum ripening and how the different processes ultimately affecting fruit quality attributes are triggered. Plum softening rate is caracterized by cell-wall swelling and pectin solubilization, which unlike other fruits occurs without a pronounced loss of galactose. Usually is observed a moderate depolymerization of pectins as the plum ripening progresses [13].

The major factor limiting the shelf-life of plums is excessive softening. [4]. The ripening-related process most sensitive to ethylene and a suitable predictor of potential shelf-life for plums is fruit softening, when CI symptoms or decay are not limiting factors [11]. Plums are considered perfet to eat when are ripened to a soft melting texture. During ripening, the cell wall extracted from plum fruit showed considerable increase in swelling and high pectin solubilization as with other fruit species [15].

The main techniques used to extend the shelf-life of fresh produce are refrigeration and proper relative air humidity control [9]. Because plums are chilling-sensitive, cold storage is limited to a few weeks. Depending on the cultivar and the post-harvest handling, fruit market life varies between 1 to 6 weeks, [5,12].

Plums cannot endure long storage periods after harvest as they are highly perishable at ambient temperatures. Thus, pre-harvest treatment of the fruits with theplant growth regulators like auxins, gibberellins, calcium chloride and growth retardants like cycocel which would retard the rate of deterioration in quality after harvest, can effectively be used to increase thestorage life of fresh fruits and thus spoilage can be reduced to some extentand thereby increasing the shelf life of the fruits [10, 16].

The vegetative phase from the beginning of fruit ripening and continuing with maximum accumulation of organoleptic qualities represent fruit maturation (the achievement of consumption maturity). In fruits occur a lot of physiological and biochemical processes, in all this time, from which result modifications of color, consistency, juicy and taste of fruits. Usaully fresh fruits are highly perishable and that can easily spoil or deteriorate during produce handling along the supply chain from the producer to the final retailer [8].

We studied in this experiment the influence of storage conditions on some quality indices on seven plum cultivars Stanley, Santa Rosa, Ciruela Fortuna, Flavor King, Record, Tuleu Gras and Bistrite.

Material and Method

The biological material was represented by seven cultivars of plum Stanley, Santa Rosa, Ciruela Fortuna, Flavor King of Greece and Record, Tuleu Gras, Bistrite of Romania (Fig. 1). Stanley has medium (30-40 g), oval, asymmetric, dark-colored, sweet, slightly acidic and slightly aromatic fruit (http://www.horticultorul.ro/pomi-fructiferi/soiuri-de-prun-stanley/). The fruit at Santa Rosa is great, dark purple, aromatic and juicy (https://www.apicepiante.eu/ro/produce/prunul-em-prunus-domestica-em-rosaceae/prunul-santa-rosa-detail). Ciruela Fortuna has red fruit, when maturation is violet color, yellow pulp, farm, sweet and acidified. (https://www.apicepiante.eu/ro/produce/prunul-em-prunus-domestica-em-rosaceae/prunul-fortune-detail). Flavor King is a plum-apricot hybrid, known as a Pluot - the flavour is plum-like but the flesh texture is similar to an apricot

(https://www.orangepippin.com/varieties/plums/flavor-king). Record has very large, appetizing, very good quality fruit with non-stick pulp, intended for fresh consumption. (https://fructifer.ro/prun-Record). The Tuleu Gras variety has medium, dark-fruited fruit with sweet and non-stick pulp. (https://www.sweetgarden.ro/prun_tuleu_gras). The Bistrite variety has medium, elongated fruit, on the navy blue, very sweet and flavored pulp. (https://www.sweetgarden.ro/prun_bistrita).

Following parameters were studied during the experiment: fruit's dimensions (fruit length, diameter, weight), firmness, fruit juice acidity, soluble carbohydrate content and dry matter.

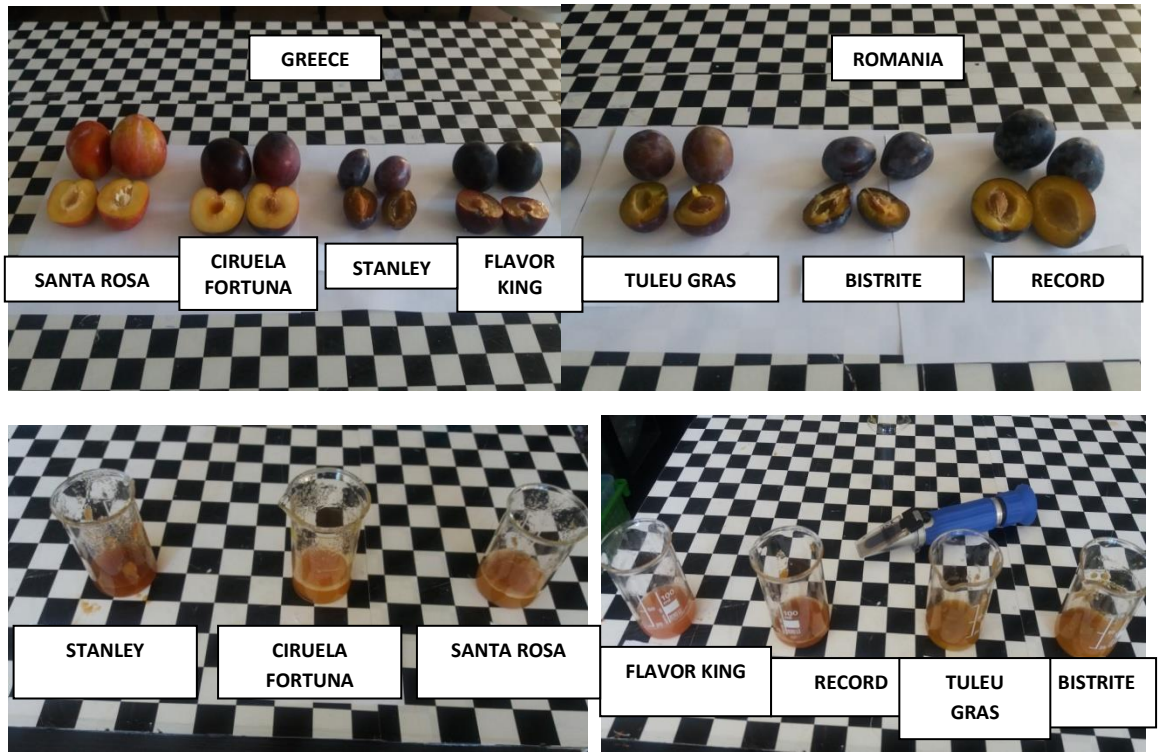

Fig. 1 The plum varieties studied

Firmness was determined using the penetrometer. The fruit juice acidity was determined using a pH-meter Force Gauge, PCE-FM 200. With digital refractometer was achieved soluble carbohydrate content, depending on the temperature determination Brix degrees was equated to the percentage [7]. The percentage of dry fruit pulp was determined using Kern thermobalance. Storage conditions were: temperature 4^0C and 25 ^{0}C, for 7 and 14 days.

Results

From the results shown in tables 1 and 2, regarding the main biometric characteristics of thefruits (length, diameter and weight), after 7 and 14 days of storage, due to post-harvesting processes, in particular the respiratory (degradation of the organic substrate) there is a reduction in the length, diameter and weight of the fruit. The Santa Rosa cultivar have registered the largest weight, length and diameter. The average of these parameters was 92.54 g for weight, 49.33 mm for length and 51.66 mm in diameter after storage at 25^0C for 14 days (Table 1). Regarding the biometric characteristics at 4^0C, it was observed that the largest length was recorded in the Santa Rosa cultivar (52.0 mm) and 101.15 g, and the smallest in Stanley (30.2 mm in diameter) and 29.24 g, after 14 days storage (Table 2).

Table 1

The biometric characteristics of fruit from the plum genotypes (25^0C)

Genotype	Length (mm)			Diameter (mm)			Weight (g)		
	First determination	7 days	14 days	First determination	7 days	14 days	First determination	7 days	14 days
STANLEY	45.1	43.35	42.0	32.8	30.5	29.5	32.879	29.955	29.10
SANTA ROSA	50.8	47	49.33	57.5	56.5	51.66	103.63	100.14	92.54
CIRUELA FORTUNA	48.2	48	45.2	55.8	54	53.5	93.28	89.185	87.13
FLAVOR KING	39.33	36	34.7	49.4	48.2	47.5	58.641	57.33	56.25
RECORD	52.25	49.5	did not resist	45.9	43	did not resist	66.134	64.74	did not resist
TULEU GRAS	40.2	39.5	did not resist	39.1	35.5	did not resist	43.905	42.105	did not resist
BISTRITE	50.5	48.6	did not resist	35.5	33.8	did not resist	39.25	37.45	did not resist

Table 2

The biometric characteristics of fruit from the plum genotypes (4^{0}C)

Genotype	Length (mm)			Diameter (mm)			Weight (g)		
	First determination	7 days	14 days	First determination	7 days	14 days	First determination	7 days	14 days
STANLEY	45.1	44.66	42.25	32.8	31.5	30.2	32.879	30.125	29.24
SANTA ROSA	50.8	49.75	52	57.5	55.75	54.5	103.63	101.673	101.15
CIRUELA FORTUNA	48.2	47.33	45.8	55.8	55	54.8	93.28	92.872	90.844
FLAVOR KING	39.33	35.75	35	49.4	49.33	48	58.641	57.97	56.66
RECORD	52.25	52	51	45.9	44.2	43.25	66.134	66.03	65.19
TULEU GRAS	40.2	40	39.66	39.1	38.4	37.8	43.905	42.818	41.04
BISTRITE	50.5	49	48.2	35.5	34.2	32.5	39.25	37.775	36.195

Determining fruit firmness, the varietal characteristics / genetic level of calcium in the fruit is also one of the most important factors. The cultivars in Greece were more firmness compared to those in Romania and after 14 days of storage, both at 4°C and at 25°C. Ciruela Fortuna had the biggest initial firmness of 1.975 lb, which decreased to 1.10 lb, after 14 days of storage at 25ºC (Fig. 2) and at 1.19 lb (4ºC). The lowest initial firmness was recorded in the Bistrite genotype (0.546 lb). After 14 days of storage, it decreased to 0.48 lb at 4ºC (Fig. 3). At 25 ºC the plums in Romania did not resist.

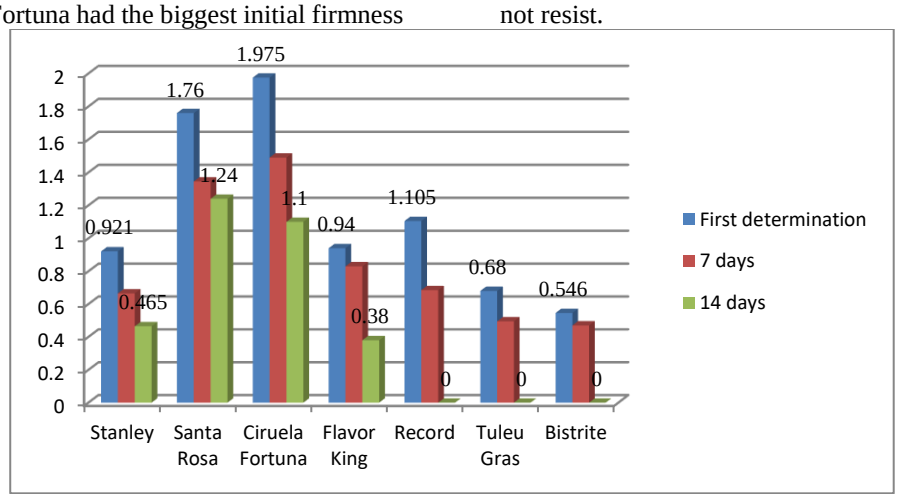

Fig. 2 Results regarding the fruits firmness in tested genotypes (lb) (25ºC)

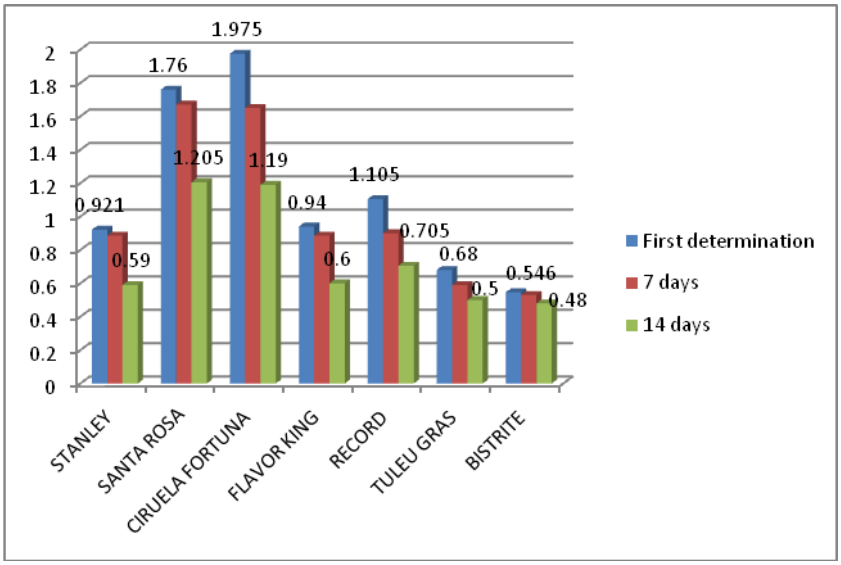

Fig. 3 Results regarding the fruits firmness in tested genotypes (lb) (4ºC)

In terms of acidity, the values obtained from the juice of fruit preserved at 4°C and 25°C were different in the seven genotypes. During the storage, a decrease in acidity was observed, the highest value being recorded in Stanley cultivar (from 3.08 to 25°C, after 14 days of storage). At 25°C, after 14 days of storage, the varieties in Romania Record, Tuleu Gras and Bistrite did not resist for the calculation of fruit acidity (Fig.4). The lowest fruit acidity was recorded in the Santa Rosa, at both 25°C and at 4°C (2.73 respectively 2.83, after 14 days of storage) (Fig.5).

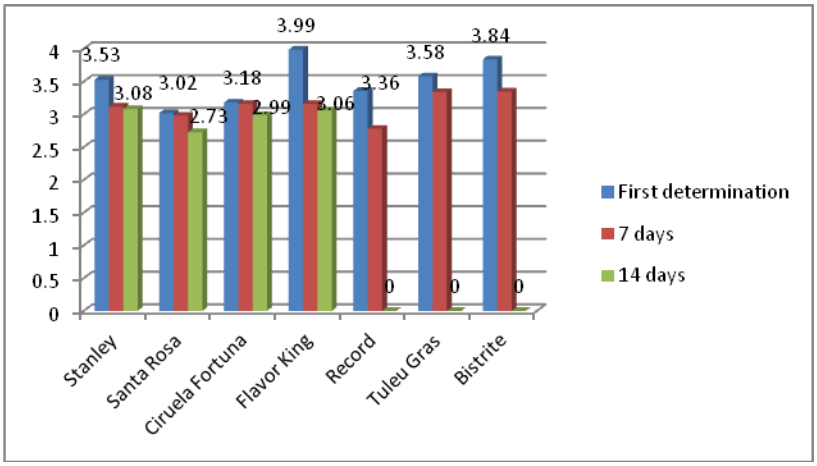

Fig. 4 Results regarding the fruits acidity in tested genotypes (25°C)

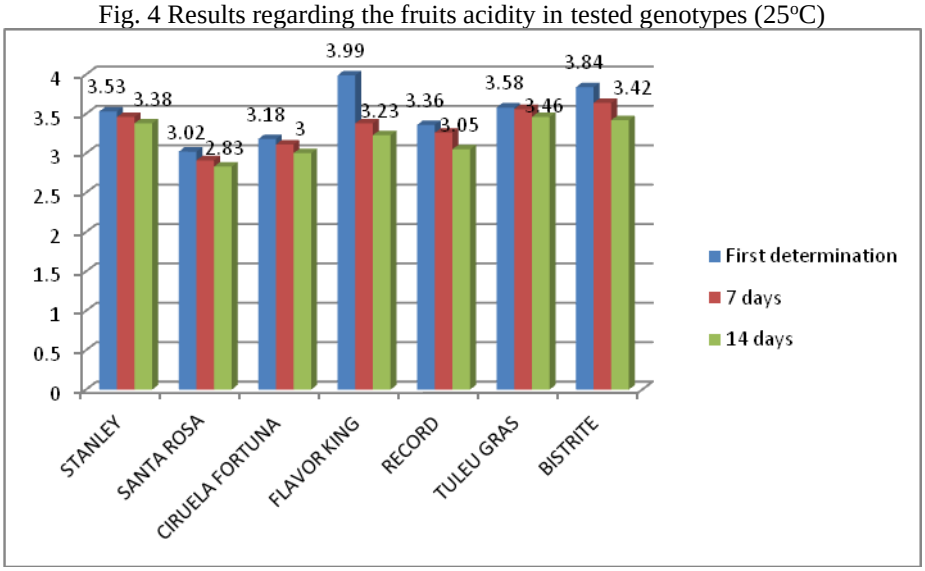

Fig. 5 Results regarding the fruits acidity in tested genotypes (4°C)

Bistrite had a good percentage of glucose content (19.0 %) at the start of the experiment in terms of total soluble carbohydrate content, while Flavor King exhibits a low total sugar content (10.3 %) (Fig.6). After 7 days of storage, all genotypes have recording significant increases of soluble carbohydrate content, the highest percentages being recorded in the Record (20.6 % to 25 °C) and Bistrite (19.5 % to 4°C). The lowest percentage of soluble carbohydrates was recorded at Flavor King (4°C) after 14 days of storage – 11.41 % (Fig. 7).

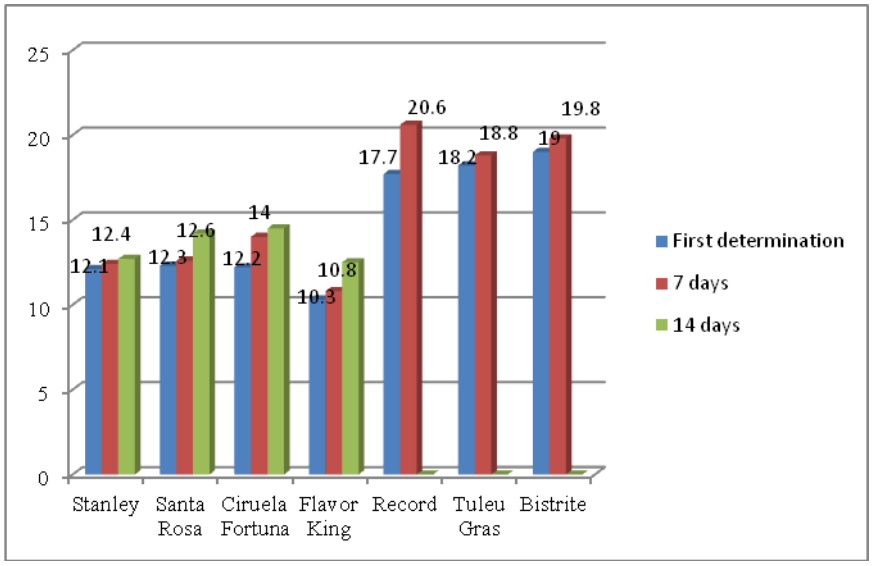

Fig. 6 Results regarding the total content of soluble glucyds in tested genotypes (25ºC) (% Brix)

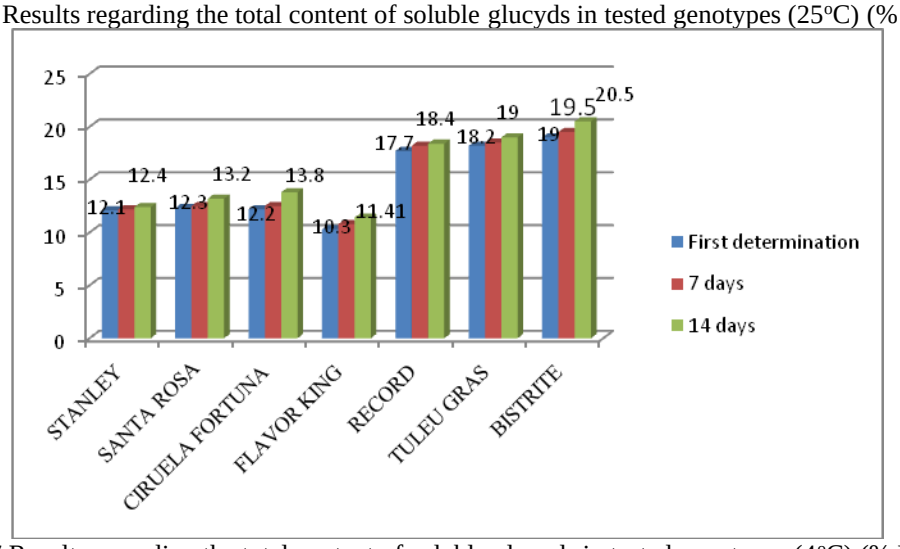

Fig. 7 Results regarding the total content of soluble glucyds in tested genotypes (4ºC) (% Brix)

Experiments have shown that plum genotypes tested have an increase during preservation in terms of dry matter content. As for the percentage of dry matter at 25°C, the lowest value was found in Flavor King by 14.132% and the highest value was recorded in the Record genotype by 30.31% after 7 days of storage (Fig. 8). At 4°C, the highest percentage was recorded also in Bistrite variety (29.902%) and lowest in Santa Rosa (16.41%) after 14 days of storage (Fig. 9).

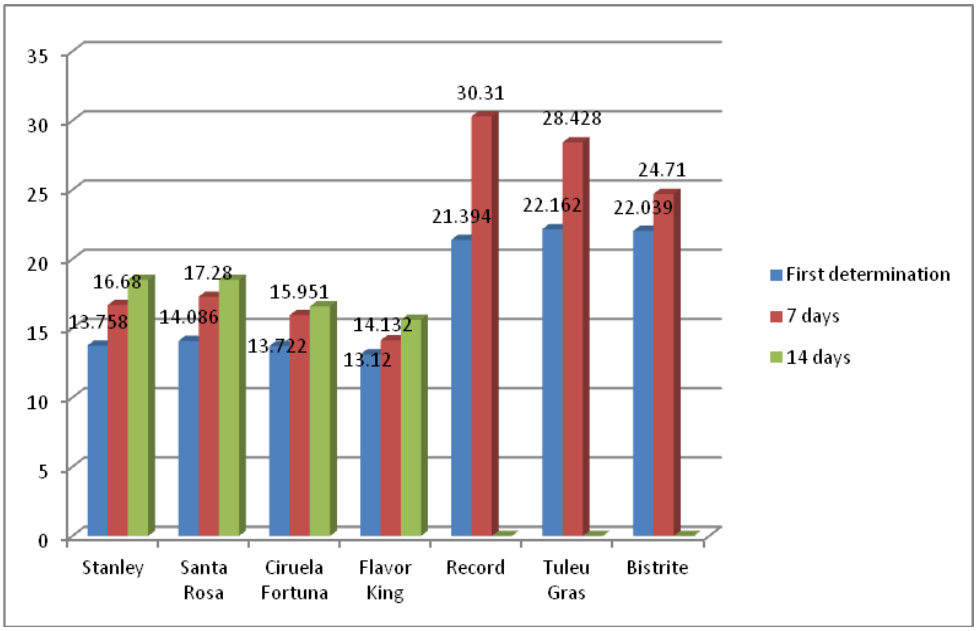

Fig. 8 Results regarding the dry matter percent in tested genotypes (%) (25ºC)

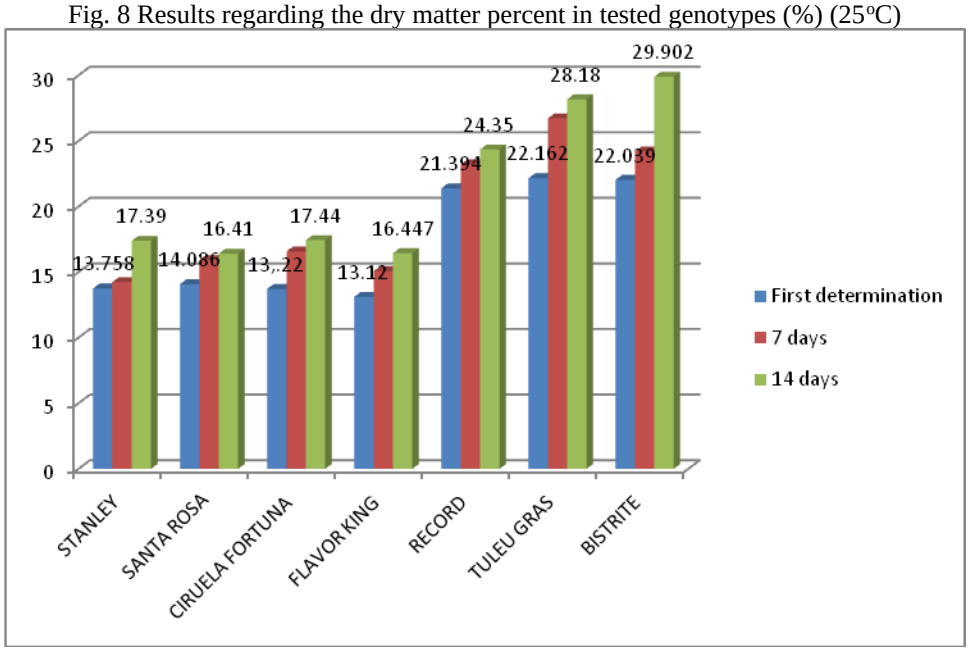

Fig. 9 Results regarding the dry matter percent in tested genotypes (%) (4ºC)

Conclusions

After analyzing the main biometric characters (diameter, length, weight) after 14 days of storage, due to the post-maturation processes, especially the respiration (organic degradation of the substrate), was observed a reduction in the diameter, length and weight of all plum genotypes tested.

Regarding acidity, the values obtained from the pulp of the fruit, stored at 4 ºC and 25 ºC, were different in the seven genotypes. During the storage has seen a trend of decreasing acidity, the highest value being recorded at the Tuleu Gras after 14 days of storage.

During fruit preservation has been a natural tendency to reduce fruit pulp firmness, the sharpest ascertaining the variety Bistrite after 7 days of storage at 25ºC.

In the case of biochemical parameters, after 14 days of storage, both at 4°C and 25°C, the tendency to continuously increase the carbohydrate content of glucose-soluble starch due to the processes of transformation in enzymatic hydrolysis is observed. At 25 ºC, after 14 days of storage the plums in Romania did not resist.

Experiments have shown that plum genotypes are a increase in dry matter content during preservation.

The plum varieties in Romania are sweeter and tasty, but can not be stored for a long time, like those in Greece.

References

1.Abdi N, Holford P, McGlasson WB, Mizrahi Y. Ripening behaviour and responses to propylene in four cultivars of Japanese type plums. Postharvest Biology and Technology 1997;12:21–34.

2.Abdi N, McGlasson WB, Holford P, Williams M, Mizrahi Y. Responses of climacteric and suppressed-climacteric plums to treatment with propylene and 1-methylcyclopropene. Postharvest Biology and Technology 1998;14:29–39.

3.Crisosto CH, Kader AA. Plum and Fresh Prune. Pomology Department, University of California, Davis, CA; 2000. Available from: URL: http://www.uckac.edu/postharv/ PDF%20files/Guidelines/plum.pdf.

4.Crisosto CH, Garner D, Crisosto GM, Bowerman E. Increasing 'Blackamber' plum (Prunus salicina Lindell) consumer acceptance. Postharvest Biology and Technology 2004;34:237–44.

5.Crisosto CH, Mitcham EJ, Kader AA. Plum: Recommendations for Maintaining Postharvest Quality. Department of Pomology, University of California, Davis; 2002. Available from: URL: http://postharvest.ucdavis.edu/Produce/ProduceFacts/Fruit/ plum.shtmlMaximum fruit market life varies from 1 to 6 weeks, depending on the cultivar and the post-harvest handling.

6.Feng, X., Apelbaum, A., Sisler, E.C., Goren, R., 2000. Control of ethylene responses in avocado fruit with 1-methylcyclopropene. Postharvest Biol. Technol. 20, 143–150.)

7.Iordanescu Olimpia Alina, Alexa Ersilia, Lalescu Dacian; Berbecea Adina; Camen Dorin; Poiana Mariana Atena; Moigradean Diana; Bala Maria, 2018. Chemical composition and antioxidant activity of some apricot varieties at different ripening stages, Chilean Journal of Agricultural Research.

8.Kader, A.A., 1999. Fruit maturity, ripening, and quality relationships. Proc.Int.Symp. on Effect of Pre- and Post Harvest factors on storage of fruit. Acta Hort. 485. ISHS.

9.Kader AA. A perspective on postharvest horticulture (1978–2003). HortScience 2003;38:1004–8.

10.Kirmani S.N., M. M. Mir, Umar Iqbal, Aarifa Jan, Kousar Javaid, A. R. Malik1 And F. A. Khan.2015. Impact of preharvest chemical application on plum (prunus salicina l.) Cv. Santa rosa quality during storage. The Bioscan, 10(1): 211-215, 2015. An International Quarterly Journal of life sciences.

11.Lelievre JM, Latche A, Jones B, Bouzayen M, Pech JC. Ethylene and fruit ripening. Physiologia Plantarum 1997;101:727–39.

12.Manganaris GA, Vicente AR, Crisosto CH, Labavitch JM. Cell wall modifications in chilling-injured plum fruit (Prunus salicina). Postharvest Biology and Technology 2007; doi:10.1016/j.postharvbio.2007.09.017.

13.Manganaris G. A. , A. R. Vicente and C. H. Crisosto, Effect of pre-harvest and post-harvest conditions and treatments on plum fruit quality.CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 2008, No. 009, doi: 10.1079/PAVSNNR20083009.)

14.Martinez-Romero D, Dupille E, Guillen F, Valverde JM, Serrano M, Valero D. 1-Methylcyclopropene increases storability and shelf life in climacteric and nonclimacteric plums. Journal of Agricultural and Food Chemistry 2003;51:4680–6.

15.Redgwell RJ, Fischer M, Kendal E, MacRae EA. Galactose loss and fruit ripening: high-molecular-weight arabinogalactans in the pectic polysaccharides of fruit cell walls. Planta 1997;203:174–81.

16.Shazia, H, Mir, M. A, Singh, D. B, Hayat, N and Khan, F. U. 2013.Effect of post-harvest treatment and storage conditions on quality of plum cv. Santa Rosa. Progressive Horticulture. 45: No. 1.

17.Zuzunaga M, Serrano M, Martinez-Romero D, Valero D, Riquelme F. Comparative study of two plum (Prunus salicina Lindl.) cultivars during growth and ripening. Food Science and Technology International 2001;7:123–30.]:

*** http://www.horticultorul.ro/pomi-fructiferi/soiuri-de-prun-stanley/

*** https://www.apicepiante.eu/ro/produce/prunul-em-prunus-domestica-em-rosaceae/prunul-santa-rosa-detail

*** https://www.apicepiante.eu/ro/produce/prunul-em-prunus-domestica-em-rosaceae/prunul-fortune-detail

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https://www.orangepippin.com/varieties/plums/flavor-king

*** https://fructifer.ro/prun-Record

*** https://www.sweetgarden.ro/prun_tuleu_gras

*** https://www.sweetgarden.ro/prun_bistrita