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RESEARCH REGARDING THE QUALITY AND PRESERVATION CAPACITY OF SOME PEAR CULTIVARS STORED IN DIFFERENT ENVIRONMENTS

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Abstract

Modern quality standards require a series of steps meant to contribute to having a diet consisting of high-quality fresh fruit, regardless of season. Their preservation is an essential technological stage in the maintaining of qualitative and quantitative food attributes. Keeping this in mind, we conducted comparative research on different local and international pear cultivars with the aim to rank fruit in terms of quality, and testing two preservation methods in different environments. The distribution of experimental options are as follows: V_1*- Fruit storage in environmental conditions, at 29*^{0}*C and 75% relative humidity, under modified atmosphere, by using a plastic semipermeable pellicle;* V_2*-Fruit storage in refrigerated condition, at 4*^{0}*C and 90% relative humidity, under modified atmosphere, by using an plastic semipermeable pellicle. Observations and physical and chemical determinations regarding the evolution of the quantitative and qualitative changes during the preservation process were made every 30 and 60 days respectively. Following a fruit tasting process, the 'Red Williams', 'Abate Fetel' and 'Nashi' cultivars were deemed "extra" class, whereas 'Williams' and 'Carmen' were deemed class I. Preserving period of fruit varied depending on the cultivar and the experimental method used. The* V_1 *storage option showed greater weight loss and decreased biochemical components decreased more, with different values depending on the cultivar and the duration of storage. For* V_2*, the lowest amount of vitamin C loss was recorded for the 'Red Williams' cultivar. 'Carmen' proved to be the most resistant cultivar because it showed the lowest average weight loss and pulp consistency.*

Key words**:** *cultivar, quality, semipermeable pellicle, firmness, perishability*

INTRODUCTION

The dietary value of pears is represented by their chemical components and nutritional elements that are easily accessible for assimilation. Fruits are indispensable in rational human nutrition, and have multiple uses (fresh consumption, dehydrated fruits, compotes, marmalades, cider, distillates). Pear cider, known as perry, is appreciated and used in western European countries [3].

Because of their superior taste when compared to other fruits, pears are an excellent source of carbohydrates providing an optimal amount of sugars and fibres [2].

Pears are mainly consumed fresh and they reach their highest taste qualities at the optimum time of harvest [4]. The cultivar range is represented by varieties with different periods of ripening, ensuring fresh fruits for 10 months a year.

By keeping them in cooling rooms, the qualities of pears can be maintained until the next harvest [1]. Compositionally, the fruit consists mainly of pulp (97%), skin (2.5%), seeds (0.5%), and the yield in juice can reach 95% of the fruit weight.

Their sugar content is between 6.5 and 15. 2%, and they contain other substances such as: pectin substances (0.14-0.71%), tannin substances (0.06-0.27%), mineral substances (0.14 - 0.54%), and vitamin C (0.6-4.7 mg %). Total acidity is between 0.12 and 0.59%.

The perfecting of preservation techniques that are meant to maintain fruit in a state as close to the harvesting state as possible remains a highly important technological priority [10].

MATERIALS AND METHODS

The research was carried out using 5 international cultivars, namely 'Red Williams', 'Abate Fetel', 'Nashi', Williams' and 'Carmen' (Fig. 1). They were sampled from the fruit batches of a private producer from S.C. Transmim S.R.L., which is located around Slobozia, Ialomița County. They were analysed and kept under the conditions available at the laboratory of the Faculty of Horticulture in Bucharest.

Fig.1. General view of the analyzed pear cultivars
Source: Original.

Research was carried out in order to determine the weight, shape, size, firmness and colour of the fruits using an analytical scale, calibration rings, reference samples, plates, penetrometer, and colour code [6]. After harvesting, the fruits were analysed from an organoleptic point of view using the standard rating sheet, in order to be included in their respective quality classes [7]. In order to test their storage capacity and to determine the evolution of their main physical and biochemical characteristics, the experiment consisted of two trials:

V_1- Fruit storage in ambient conditions, at 29^0C and 75% relative humidity, under modified atmosphere, by using a plastic semipermeable pellicle;

V_2-Fruit storage in refrigerated condition, at 4^0C and 90% relative humidity, under modified atmosphere, by using an plastic semipermeable pellicle.

RESULTS AND DISCUSSIONS

Assessing fruit quality classes

An important element for the assessment of the quality of the fruits and their classification into quality categories was the organization of a session of organoleptic analysis, as well as the determination of quality indices, respectively the size and the average weight of the fruits [5]. The standard score sheet was used as a tool for the visual and organoleptic analysis of fruits and the results are shown in Table 1.

Table 1. The organoleptic fruit quality assessment sheet

Organoleptic quality analyzed	Grading	Cultivar				
		Abate Fetel	Carmen	Nashi	Williams	Red Williams
Size	3.....1	3	2	3	3	3
Typical shape	3.....1	3	3	3	3	3
Skin color	4.....1	3	3	4	2	4
Skin state	4.....1	4	2	3	2	4
Pulp color	3.....1	3	3	3	2	3
Pulp consistency	3.....1	3	3	3	1	3
Pulp juiciness	3.....1	3	2	3	3	3
Taste	7.....1	6	5	6	2	6
Aroma	4.....1	4	3	3	2	4
Total points	34....9	**32**	**26**	**31**	**20**	**33**
Quality class	**Extra 30-34**	X		X		X
	Quality I 20-29		X		X	
	Quality II 10-19					

Source: own determination.

By analysing the comparative data in the tasting sheet, it became apparent that 'Red Williams' (33 points), Abate Fetel (32 points), Nashi (31 points) had the highest qualities and were 'extra' class. They were followed by Carmen (26 points) and Williams (20 points), as class I fruit. The cultivars in the 'extra' class were preferred by consumers for the following reasons: -'Red Williams ranked first and showed remarkable qualities due to its balanced glucoses versus acidity ratio, coupled with very pleasant color, consistency and specific flavor;

- Abate Fetel' led the ranking in terms of fruit size, skin color, taste and its particular aroma.

It ranked second, while Nashi ranked 3rd place.

Qualitative and quantitative changes of fruit during storage. Storage period is a genetic capacity of fruit rendered by their resistance to alteration processes post-harvest without losing significant qualitative and quantitative traits [8]. Tables 2,3,4 and 5, show the evolution of these characteristics during storage:

Average fruit size

Table 2. The fruit average weight evolution during the storage period

Experiment	Cultivar	Average weight (g) / Storage period (days)				
		Harvest time (g)	30 days	Loss (%)	60 days	Loss (%)
V_1 (20°C, RH 75%)	Abate Fetel	341	260	23.7	170	50.1
	Carmen	148	102	31.0	74	50.0
	Nashi	235	198	15.7	116	50.6
	Williams	193	141	26.9	97	49.7
	Red Williams	169	129	23.6	98	42.0
V_2 (4°C, RH 90%)	Abate Fetel	341	305	10.5	277	18.7
	Carmen	148	125	15.5	115	22.2
	Nashi	235	213	9.3	202	14.0
	Williams	193	165	14.5	157	18.6
	Red Williams	169	148	12.4	135	20.1

Source: own determination.

For V_1, the largest quantitative loss during the same 30-day storage period was for 'Carmen' (31.0%). The lowest amount of weight loss was for 'Nashi' (15.7%). This was due to higher pulp humidity and a denser bloom. After 60 days in storage the weight loss increased to a larger extent, depending on the cultivar. The largest weight loss was registered for Abate Fetel (50.1%) due to the fruits having a larger skin surface and a lower amount of bloom. In the case of V_2, fruits showed less weight loss than for V_1, which was mainly due to the cooling room's temperature (4°C) as well as its relative humidity (90%).

Fruit firmness

During the storage period the fruit firmness change their values, depending of the variety, of the storage period and the storage condition [9].

Table 3. The fruit firmness evolution during the storage period

Experiment	Cultivar	Pulp firmness (kgf/cm^2) / Storage period (days)				
		Harvest time kgf/cm^2	30 days	Loss %	60 days	Loss %
V_1 (20°C, RH 75%)	Abate Fetel	9.1	8.5	6.6	7.1	21.9
	Carmen	8.7	8.0	8.0	7.3	16.0
	Nashi	10.6	9.5	10.3	8.6	25.2
	Williams	8.4	7.2	14.2	6.6	21.2
	Red Williams	9.6	8.8	8.3	7.2	25.0
V_2 (4°C, RH 90%)	Abate Fetel	9.1	8.9	2.2	8.6	5.5
	Carmen	8.7	8.4	3.4	8.1	6.9
	Nashi	10.6	10.2	3.7	9.8	7.5
	Williams	8.4	7.9	5.9	7.5	10.7
	Red Williams	9.6	9.4	2.1	9.0	6.2

Source: own determination.

The obtained results showed a direct correlation between the fruits firmness and the pulp mechanical strength.

It was noted that the ripening of the fruit decreased pulp firmness progressively. In the V_1 option, the fruits showed changes in the consistency of their pulp in terms of value, with slight variations from one cultivar to another. Thus, the biggest losses in the case of the V_2 option were demonstrated by the 'Williams' cultivar (14.2%) at 30 days, and at 60 days for the 'Nashi' varieties (25.2%), 'Red Williams' (25.0%), and 'Williams' (21.2%). In V_2, a lower perishability is noted and therefore an extension of the duration of storage of the fruits, compared to the first option, due to the storage conditions in the cooling room. 'Abate Fetel' proved to be the most resistant to preservation after 60 days, due to the high firmness of its pulp, but also because to its thicker bloom which prevented the water from evaporating from the fruit pulp.

Soluble dry matter

Research has shown that there were notable differences between the two experimental options. For V1, after 30 days of storage, the 'Nashi' cultivar showed the most important decrease of soluble dry matter (11.3%), while the other varieties showed intermediate values, compared to the 'Carmen' cultivar,

where the soluble dry matter content decreased the least (3.2%).

Table 4. The soluble dry matter evolution during the storage period

Experiment	Cultivar	Vitamin C (mg/100g fresh produce)				
		Harvest time (mg/100g pp)	30 days	Loss (%)	60 days	Loss (%)
V_1 (20°C, RH 75%)	Abate Fetel	4.6	4.1	9.7	1.9	47.3
	Carmen	7.9	7.0	11.2	3.5	49.2
	Nashi	5.7	5.1	9.7	2.3	59.4
	Williams	5.1	4.8	4.5	2.1	58.8
	Red Williams	4.9	4.0	18.6	2.2	55.0
V_2 (4°C, RH 90%)	Abate Fetel	4.6	4.3	5.4	3.4	26.0
	Carmen	7.9	7.4	6.3	5.9	25.0
	Nashi	5.7	5.3	6.2	4.3	24.6
	Williams	5.1	4.7	6.2	3.8	25.1
	Red Williams	4.9	4.6	7.6	3.7	25.7

Source: own determination.

After 60 days of storing the fruits under the same conditions, the reserves of soluble dry matter decreased the most in the 'Red Williams' cultivar (16.6%), and the least in the 'Carmen' cultivar (10.2%). Analyzing the losses in the case of V2, there were some gradual changes regarding the soluble dry matter content according to cultivar. Thus, the 'Nashi' cultivar showed the largest decrease of soluble dry matter, 8.9% at 30 days and after 60 days of storage under similar conditions, the 'Red Williams' cultivar showed a loss of 16.8%. Regardless of the experimental variant in the 'Carmen' cultivar, the smallest percentage decrease of the soluble dry matter content was found.

Vitamin C

As far as vitamin C is concerned, there were significant variations in fruit during various stages, from harvest to storing period. In the case of V_1, there was significant loss of vitamin C due to the storage conditions where the oxidative processes took place more intensely compared to V_2.

'Red Williams' showed the highest loss of vitamin C content in the case of V_1 – 18.6%, at 30 days, and 60 days for 'Nashi' at 59.4%. The environment conditions present in V_2 show a significant loss of vitamin C content of 4.6% at 30 days and 60 days for 'Abate Fetel' at 26.0%.

Table 5. The vitamin C evolution during the storage period

Experiment	Cultivar	Soluble dry matter (%) / Storage period (days)				
		Harvest time (%)	30 days	Loss (%)	60 days	Loss (%)
V_1 (20°C, RH 75%)	Abate Fetel	17.3	15.9	7.6	13.8	12.1
	Carmen	15.8	15.2	3.2	13.6	10.2
	Nashi	12.3	10.9	11.3	8.0	17.0
	Williams	15.0	13.7	8.2	12.0	11.3
	Red Williams	15.2	13.8	9.3	11.3	16.6
V_2 (4°C, RH 90%)	Abate Fetel	17.3	16.3	5.6	14.4	11.1
	Carmen	15.8	15.5	1.8	14.3	9.3
	Nashi	12.3	11.2	8.9	9.5	14.5
	Williams	15.0	14.1	5.8	12.6	15.6
	Red Williams	15.2	14.5	5.0	12.7	16.8

Source: own determination.

CONCLUSIONS

As a result of the organoleptic appreciation, the fruits of the 'Red Williams', 'Abate Fetel' and 'Nashi' varieties were deemed "Extra" class due to their exceptional size, shape and taste;

The size of the harvested fruits was variable from one cultivar to another, depending on the age of the tree, the culture technology and the climatic conditions of the harvest year;

'Abate Fetel' had the highest average fruit weight (341.0 g), being also a specific cultivar characteristic;

The low values of the average weight of the fruits in the 'Carmen' cultivar (148.0 g) were due to the high load of fruit on the tree, as a consequence of the quite high productive potential of the cultivar compared to the other cultivars, as well as the failure to perform the operation of balancing the fruit load on the tree.

The storage capacity of the fruits was variable according to the variety and the storage condition;

In the case of V_1, at the end of 60 storage days, the Red Williams variety registered the lower weight losses;

For the V_2 variant, there is a lower average weight loss of the fruits, compared to V_1, due to bouth the low temperature conditions (4°C), relative humidity (90%), and the protection of the fruits with semi-permeable plastic film;

During storage, the consistency of the fruits gradually decreased according to the variety, storage duration and condition;

For the V_1 variant, the value of soluble dry matter decreases more significant, according to the variety and the storage periods;

The storage method of the V_2 option showed the smallest loss of vitamin C after 60 for the 'Nashi' cultivar.

For the consistent supply of the market with fresh and high-quality fruit, V_2 is recommended as a storage method, under cold conditions, at a temperature of 4°C, relative humidity of 90%, as well as protected by a semi-permeable plastic pellicle.

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