THE INFLUENCE OF TREATMENT WITH HIGH TEMPERATURE APPLIED ON APPLE FRUITS, IN ORDER TO MAINTAIN THEIR QUALITY DURING COLD STORAGE

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Abstract

The exposure of the fruit for a short time at high temperatures attenuates some maturation processes. The ethylene production is reduced due to the inhibition of some enzymes. Even if by this treatment the fruits suffer a thermal shock of low intensity, at the end of the storage period, the fruits will present a superior quality compared to the control. (Anghel Roxana Mihaela 2008, 2009)

Key words: heat treatment, high temperature, fruit quality, cold stores

The heat treatment with hot water is used to prevent degradation caused by pathogens and successfully applied to apples, avocados, citrus, plums, etc. (Ben-Yehoshua S. and Porat R., 2005).

MATERIAL AND METHOD

The apple fruits from the Generos, Starkrimson, Idared and Ionagold varieties were harvested in late September 2010 from the Iasi fruit basin. The fruits were stored in Sarca warehouse, in order to achieve cool preservation. Here, before being introduced into cells, were thermally treated at high temperatures.

Heat treatment consisted of fruit immersion in heated water at a temperature of 30^0C for 5 minutes and then immersing them in water at 50^0C for 3 minutes.

Initially, because the fruits were at a temperature of 15 to 18 ^{0}C, a transition temperature was used not to cause a physiological shock to the fruits.

After the evaporation of external moisture, all varieties have been stored in cold cell to ensure 2^0C temperature, a relatively high humidity of 90-95% and allow air circulation speed of at least 0.25 m / s, at the recirculation rate of 30 recycles / hour.

Monthly samples were taken from each variable and variety, which were analyzed in the laboratory of the discipline "The technology of horticultural products", from the "University of Agriculture Science and Veterinary Medicine" from Iasi.

A series of physical measurements and chemical analysis were made to these samples to estimate their physiological state and biochemical content.

Thus, they were determined:

-Test to estimate the starch content, through the sample with iodine;

-Soluble solids content, refractometry method;

-Total acid content, titration method;

-Determination of the respiration intensity with the Pettenkofer device;

-Structural-texture firmness determination with Stanhope Settat penetrometer.

RESULTS AND DISCUSSIONS

During cold preservation the next values were obtained.

Table 1

The evolution of starch content (note to the sample with iodine) of fruits during cold preservation

month / Varietis, samples	October	November	December	January	February	March	April
Generos blank	7,8	8,0	9,0	9,8	10,0	10,0	10,0
Generos treated	7,8	7,8	8,4	8,6	9,0	9,4	9,6
Starkrimson blank	7,6	8,0	9,0	9,8	10,0	10,0	10,0
Starkrimson treated	7,6	7,8	8,6	8,8	9,2	9,4	9,6
Idared blank	7,2	8,0	9,0	9,6	10,0	10,0	10,0
Idared treated	7,2	7,8	8,4	8,8	9,2	9,4	9,8
Ionagold blank	7,8	8,0	9,0	9,8	10,0	10,0	10,0
Ionagold treated	7,8	7,8	8,4	8,8	9,0	9,2	9,8

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Table 2

The evolution of soluble solid content (Bx) of fruits during cold preservation

month / Varietis, samples	October	November	December	January	February	March	April
Generos blank	12,2	12,8	13,2	13,6	13,4	12,8	12,0
Generos treated	12,2	12,4	12,8	13,2	13,4	13,8	14,0
Starkrimson blank	13,2	13,8	14,0	14,6	14,0	13,2	12,4
Starkrimson treated	13,2	13,0	13,4	13,6	14,4	14,8	14,8
Idared blank	11,6	12,2	12,8	13,4	13,2	12,4	11,8
Idared treated	11,6	11,8	11,6	11,8	12,0	12,6	13,0
Ionagold blank	11,2	11,8	12,4	13,0	12,6	11,6	11,0
Ionagold treated	11,2	11,4	11,4	11,8	12,6	13,0	13,4

Table 3

The evolution of titrated acid (g product g malic/100 acid) on fruits during cold preservation

month / Varietis, samples	October	November	December	January	February	March	April
Generos blank	0,63	0,56	0,55	0,48	0,40	0,38	0,36
Generos treated	0,63	0,58	0,57	0,52	0,49	0,46	0,39
Starkrimson blank	0,38	0,34	0,30	0,27	0,22	0,21	0,20
Starkrimson treated	0,38	0,34	0,32	0,29	0,28	0,25	0,23
Idared blank	0,61	0,58	0,56	0,44	0,37	0,33	0,27
Idared treated	0,61	0,58	0,57	0,51	0,47	0,41	0,37
Ionagold blank	0,57	0,52	0,50	0,42	0,35	0,31	0,25
Ionagold treated	0,57	0,53	0,51	0,46	0,42	0,37	0,34

Table 4

The evolution of structural-textural firmness (PU / 5 sec) during cold preservation

month / Varietis, samples	October	November	December	January	February	March	April
Generos blank	23	25	28	33	38	40	42
Generos treated	23	25	27	29	32	36	39
Starkrimson blank	19	20	24	28	32	36	38
Starkrimson treated	19	20	23	26	28	30	34
Idared blank	25	28	32	38	42	44	45
Idared treated	25	27	31	34	37	40	42
Ionagold blank	24	27	30	34	39	41	43
Ionagold treated	24	26	30	32	35	37	40

In table 1 we see that the fruits were harvested at the optimum degree of starch hydrolysis. On treated fruits are noticeable a less and constant solubization of starch, while the control samples have exhausted since February all reserves of starch.

In table 2 we can see the evolution of soluble solids content in stored fruits.

Until February, in the control samples' case, the value of soluble dry content increased steadily due to the transformation of starch into simple sugars by hydrolysis. After this period the content decreases as simple carbohydrates being consumed in metabolism.

In the case of treated variants the starch hydrolysis process continues throughout the preservation process and thus the content in soluble dry content increases. From the treated varieties, Starkrimson stands with the highest soluble solids content (14,8^{0}Bx).

The content in acid, expressed in titratable acidity (table 3) had the same trend of decreasing during cold preservation, noting that at the end of storage the control samples have a much lower content in organic acids than the treated variants.

In the first two months of storage, are observed close values of the control sample with treated variants, but since January is revealed a more pronounced loss in acid content on the control samples.

The varieties Idared and Generos get remarked, having the highest acid content (0.39 and 0.37 g respectively of malic acid /100 g product).

The structural-textural firmness (Table 4) measured in penetrometric units (PU) during a certain time (5 seconds) shows the traveled distance by the penetrometric needle inside the fruit (1 PU = 0.1 mm). A great value of this parameter indicates a low firmness. In the first two months of cold storage there were significant differences between treated and control samples, in all analyzed varieties. This is due to a mild hydrolysis of pectin during heat treatment. But, starting with February is found in the control samples a more pronounced degradation of the structural -textural firmness.

The treated variants have a better firmness than the control samples in all analyzed varieties.

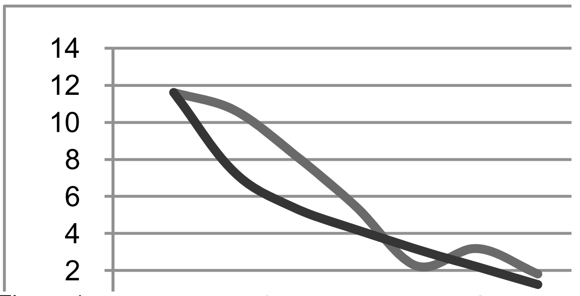

Figure 1 **The intensity of breathing on the Generos variety during cold preservation**

Breathing intensity was measured at a constant temperature 20ºC and expressed in $cm^3CO_2/Kg/h$.

The tested sample highlights the climate in February. The descendant trend of values of this parameter indicates that the fruits have a much slowed metabolism. On the treated variant is observed, since the first month, that the intensity of respiration is lower than the control variant, following an almost linear decrease, but without reaching a clear climate.

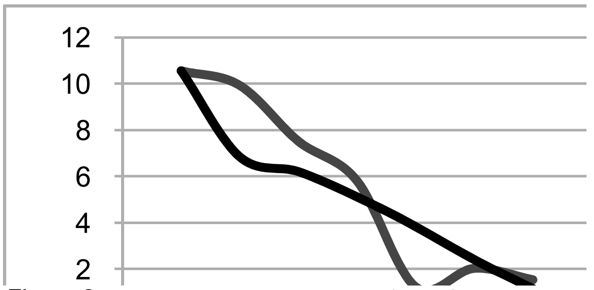

Figure 2 **The breathing intensity of the Starkrimson variety during cold preservation**

Under the influence of heat treatment (fig.2), the fruits had a reduced metabolism during cold preservation, gradually decreasing the intensity of respiration.

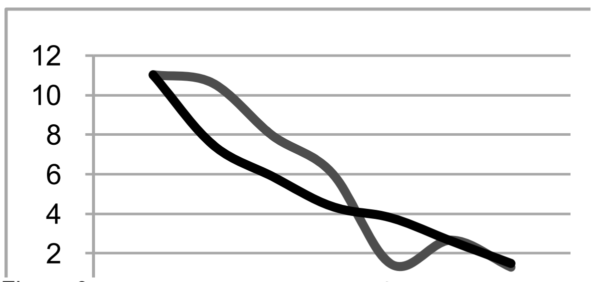

Figure 3 **The breathing intensity of the Idared variety during cold preservation**

On the Idared variety we notice a relatively sharp decrease in the intensity of respiration in the control variant, until February. The treated variant has a constant decrease of this parameter.

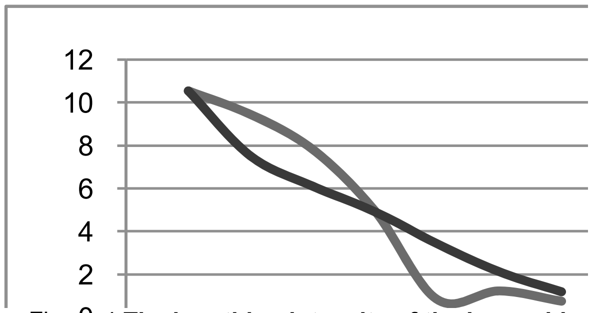

Figure 4 **The breathing intensity of the Ionagold variety during cold preservation**

Also on the Ionagold blank variety, the values of breathing intensity showed the climate phase in February.

CONCLUSIONS

The heat treatment influenced positively the quality of stored fruits in refrigerated conditions. We see rather large differences since November, first month of cold storage, both between species and between variants.

The starch hydrolysis was complete as early as February for the fruits control samples.

In this period was highlighted the respiratory climate also, indicating rapid depreciation of the fruits after the fourth month of storage.

Thus, both the organic acid content and soluble solids decreased significantly in fruits control samples.

Structural-textural firmness is higher in heat treated fruits.

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