THE INFLUENCE OF WAX PROTECTION FILM ON APPLE FRUITS, IN ORDER TO MAINTAIN THEIR QUALITY DURING COLD STORAGE

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Abstract

The physical properties and especially the chemical ones of the beeswax classify it among the best materials to manufacture edible films. It has high hardness, stability, is insoluble in water, semi-permeable for gases, is chemically inert and the taste and smell will not print. Wax contains, in addition to fatty acids and saturated hydrocarbons, free acids, free alcohols and water (Anghel Roxana Mihaela, 2009).

Key words: edible film, beeswax, fruit quality, cold stores

The undertaken studies in this area have concluded that the wax film, besides the microbiological protection given by the preserved product, acts as a barrier against moisture, due to the effective closure of the fruit skin pore (Anghel Roxana Mihaela, 2008, 2009).

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. They were transported to Sarca fruit warehouse, for cold storage. The treatment was applied on the 15th of October, with a skin solution prepared from 40 grams of wax, 100 ml of alcohol 98% vol and 3800 ml distilled water. This amount is required per 100 kg of fruits. The fruits were immersed in a skin solution of wax, concentration 1%.

This film, at this concentration in wax, has the optimal properties for treatment: full coverage and good grip on the fruit.

After the evaporation of external moisture, all varieties have been stored in cold cell to ensure 2^{0}C 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 Setta 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	8,0	8,2	8,8	9,2	9,4
Starkrimson blank	7,6	8,0	9,0	9,8	10,0	10,0	10,0
Starkrimson treated	7,6	7,8	8,0	8,4	8,8	9,0	9,4
Idared blank	7,2	8,0	9,0	9,6	10,0	10,0	10,0
Idared treated	7,2	7,4	7,4	7,8	8,6	8,8	9,6
Ionagold blank	7,8	8,0	9,0	9,8	10,0	10,0	10,0
Ionagold treated	7,8	8,0	8,2	8,6	9,0	9,6	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	12,6	13,0	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	13,4	13,6	14,0	14,2	14,6	14,6
Idared blank	11,6	12,2	12,8	13,4	13,2	12,4	11,8
Idared treated	11,6	12,0	12,2	12,6	13,2	13,4	13,8
Ionagold blank	11,2	11,8	12,4	13,0	12,6	11,6	11,0
Ionagold treated	11,2	11,4	11,8	12,2	12,6	13,0	13,2

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	0,60	0,58	0,54	0,51	0,48	0,40
Starkrimson blank	0,38	0,34	0,30	0,27	0,22	0,21	0,20
Starkrimson treated	0,38	0,36	0,34	0,32	0,30	0,27	0,25
Idared blank	0,61	0,58	0,56	0,44	0,37	0,33	0,27
Idared treated	0,61	0,59	0,57	0,53	0,49	0,43	0,39
Ionagold blank	0,57	0,52	0,50	0,42	0,35	0,31	0,25
Ionagold treated	0,57	0,55	0,54	0,49	0,45	0,39	0,36

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	24	25	26	29	33	38
Starkrimson blank	19	20	24	28	32	36	38
Starkrimson treated	19	20	21	23	27	29	33
Idared blank	25	28	32	38	42	44	45
Idared treated	25	27	29	32	34	36	40
Ionagold blank	24	27	30	34	39	41	43
Ionagold treated	24	26	28	31	33	36	38

In table 1 we see that the fruits were harvested at the optimum degree of hydrolysis for storage in cold places. The hydrolysis of starch was more pronounced in all control samples, from February being able to observe a depletion of starch reserve.

In table 2 we can see the evolution of soluble solid content in stored fruits. For all studied varieties, in the early period of cold storage the control samples had a higher content in soluble solid from the treated variants.

In the first months of storage, soluble solid content increases due to hydrolysis of starch from fruits. After the starch reserve is consumed, the content in soluble solids decreases due to its gradual depletion in metabolic processes. This phenomenon is seen in variants starting from March.

At the end of cold storage, the treated variants had a higher content in soluble solids compared to the control samples.

Among the studied varieties Starkrimson stands out with the highest soluble solids content. The Ionagold variety presents the driest soluble solids content. The same trend of increase in soluble substances content occurs throughout the cold preservation, in all studied varieties, due to the increasing content in simple carbohydrates, as the gradual hydrolysis of starch.

The titrable acidity (tab. 3) had the same decreasing trend during cold preservation, noting that at the end of storage witness variants have a much lower content in organic acids than the variants treated. The varieties Idared and Generos get remarked, having the highest acid content (0.40 and 0.35 g respectively of malic acid /100 g product).

The structural-textural firmness (tab. 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.

From the results is to be noted that the fruits retain their firmness in the first 3 months of cold storage, a more pronounced decrease being

recorded during February-April. Also to be noted that the treated variants present a better firmness than the control sample, all varieties having lower values for this parameter.

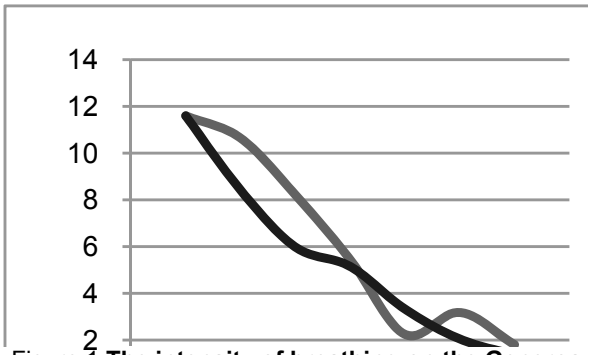

Figure 1 **The intensity of breathing on the Generos variety during cold preservation**

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

The breathing intensity graph for the Generos variety highlights the climate point to control variant in February.

The downward trend of values for this parameter indicates that the fruit metabolism is much slowed. At the treated variant is observed from the first month, that the intensity of respiration is lower than the control variant, following a nearly linear decrease, but without reaching the climate point.

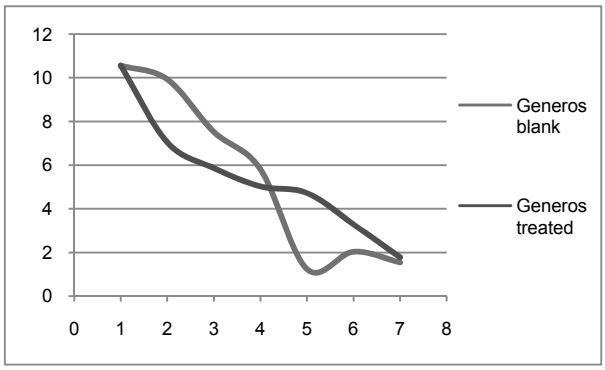

Figure 2 **The breathing intensity of the Starkrimson variety during cold preservation**

In the Starkrimson variety is also observed for the control variant the climate point in February. Under the influence of skin treatment, the fruits had a low metabolism, the decrease being constant during cold preservation.

On the Idared variety is observed a relatively sharp decrease in breathing intensity at both varieties, but at different times. For the control variant, the decrease is constant in the first four months (until February), when is observed the entry of fruits in climacteric faze, and on the treated variant the decrease is pronounced during January-April.

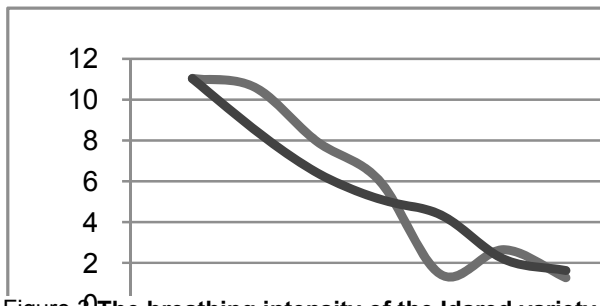

Figure 3 **The breathing intensity of the Idared variety during cold preservation**

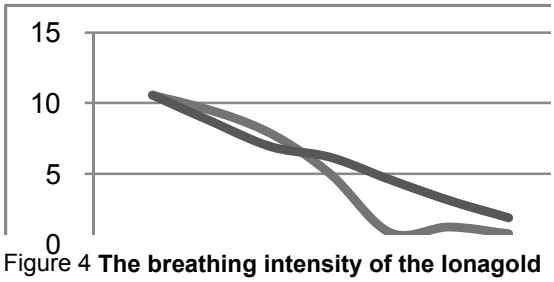

Figure 4 **The breathing intensity of the Ionagold variety during cold preservation**

On Ionagold variety the metabolism of the treated fruits was lower compared to the control variety in the first three months of storage, from January starting to register a linear decrease.

CONCLUSIONS

The treatment of skin with wax film at a concentration of 1% applied to apple varieties like Generos, Starkrimson, Ionagold and Idared maintained a high fruit quality.

Significant differences were observed since the first month of cold storage, both between varieties and between variants.

The degree of starch hydrolysis was greatly enhanced on the control samples, so that in the first three months the reserves of starch in fruits was exhausted.

This led to a considerable increase in soluble dry content, followed by a sudden drop in this parameter, simple carbohydrates being consumed in metabolic processes.

At the end of cold storage is also observed a higher content in organic acids in the treated variants compared to the controls.

The graphical representation of the breath intensity highlights the fruit entry into climacteric phase for the control variant in February, while the treated variants fruits the breathing intensity decrease is almost constant, without evidence of climacteric point until April.

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