STUDIES REGARDING THE CARBOXYMETHYL CELLULOSE FILM PROTECTION OF APPLES SO AS TO MAINTAIN THEIR QUALITY IN THE FRIGORIFIC STOREHOUSES

STUDII PRIVIND PROTEJAREA CU PELICULĂ DE CARBOXIMETILCELULOZĂ A FRUCTELOR DE MĂR, ÎN VEDEREA MENŢINERII CALITĂŢII LOR ÎN DEPOZITELE FRIGORIFICE

ANGHEL Roxana Mihaela[1]
e-mail: roxanam77@yahoo.fr

Abstract. *The edible films have been more and more used recently to maintain the quality of fruit and vegetables during their marketing in fresh state. They already know a series of biodegradable films successfully used in the developed countries. The materials used to obtain such films must meet a series of requirements related both to the protection of the products for which they are used and the consumers' protection. Besides the protective function, these films may have benefic actions on the human body. Many of these biodegradable films are made of derivatives of cellulose and starch. Carboxymethylcellulose is obtained from cellulose which is the main polysaccharide and constituent of wood and all plants' structure. It has multiple uses, mainly as a thickening agent, but also as a filling, dietary fibers, anti-agglomerating agent and emulsifier. In medicine, carboxymethylcellulose is generally used as a gastric antacid and laxative. Carboxymethylcellulose is highly soluble and it may be fermented in the large intestine.*

Keywords: carboxymethyl cellulose, protective film, fruit quality

Rezumat. *Peliculele comestibile sunt tot mai mult utilizate în ultimul timp pentru menţinerea calităţii fructelor şi legumelor în procesul valorificării în stare proaspătă. Se cunosc deja o serie de pelicule biodegradabile, folosite cu succes în ţările dezvoltate. Materialele utilizate pentru obţinerea acestor pelicule trebuie să îndeplinească o serie de cerinţe, legate atât de protecţia produselor pentru care se folosesc, cat şi de protecţia consumatorilor. Pe lângă funcţia de protecţie, aceste pelicule pot avea acţiuni benefice asupra organismului uman. Multe din aceste pelicule biodegradabile sunt constituite din derivaţi ai celulozei şi amidonului. Carboximetilceluloza se obţine din celuloză, principalul polizaharid şi constituent al lemnului şi tuturor structurilor plantelor. Are multiple utilizări, în principal ca agent de îngroşare, dar şi ca umplutură, fibre dietetice, agent antiaglomerant şi emulgator. În medicină, carboximetilceluloza se foloseşte, în special, ca antiacid gastric şi laxativ. Carboximetil celuloza este foarte solubilă şi poate fi fermentată în intestinul gros.*

Cuvinte cheie: carboximetilceluloză, peliculă protectoare, calitate fructe

[1] University of Agricultural Sciences and Veterinary Medicine Iasi, Romania

MATERIAL AND METHOD

The apple fruits belonging to Generos, Starkrimson, Idared and Ionagold variety were subjected to a post-harvest pelicular treatment. They were immersed in a solution of carboxymethyl cellulose film, concentration 3%, before placing the mincold cells (M.B. Pérez-Gago, et colab. 2003).

After exterior moisture has evaporated, all variants were stored in the frigorific cell having a temperature of 2^0C, a relatively high humidity of 90-95% and air circulation with a speed of at least 0.25 m/s, for a circulation coefficient of 30 re-circulations/hour (Beceanu D., 2010).

We monthly drew samples from each variant and variety which were then analysed in the lab of Technology of horticultural products department within USAMV Iaşi.

These samples were subjected to a series of physical determinations and chemical analyses to estimate their physiological state and biochemical content (Anghel Roxana, 2008).

Thus, we determined:

- starch content by the iodine test
- the content of soluble dry substance by the refractometric method
- titrating acidity by the titrimetric method
- breathing intensity by means of Pettenkofer device
- structural-textural firmness by means of penetrometric method.

RESULTS AND DISCUSSIONS

In the first four months of refrigeration, the evolution of fruits was the following, presented in tables 1-4 and figures 1-4.

Table 1

The evolution of starch content (note the sample with iodine) fruit during cold storage

Period /variety	Generos blank	Generos treated	Stark rimson blank	Stark rimson treated	Idared blank	Idared treated	Ionagold blank	Ionagold treated
November	8,0	7,0	8,0	8,0	8,0	7,0	8,0	7
December	9,0	7,3	9,0	8,2	9,0	7,4	9,0	7,2
January	9,8	7,8	9,8	8,6	9,6	8,0	9,8	7,9
February	10,0	8,6	10,0	9,0	10,0	8,8	10,0	8,6
March	10,0	9,0	10,0	9,2	10,0	9,2	10,0	9
April	10,0	9,4	10,0	9,6	10,0	9,6	10,0	9,4

The harvesting of fruits for frigorific storage was made at an optimum hydrolization level of starch (tab. 1). During the frigorific storage, starch hydrolysis was more visible in all blank tests, thus since February this parameters shows that there is starch reserve in the fruit.

The evolution of the soluble dry substance (tab. 2) is correlated to the manner of starch hydrolization. The blank tests showed a high content of this parameter in the first months of storage due to the faster hydrolysis of starch. After starch has been completely hydrolyzed, the content in soluble dry substances decreases as they are consumed in the metabolic processes.

Table 2

Evolution of soluble solids content (^{0}Bx) fruit during cold storage

Period /variety	**Generos blank**	**Generos treated**	**Stark rimson blank**	**Stark rimson treated**	**Idared blank**	**Idared treated**	**Ionagold blank**	**Ionagold treated**
November	12,8	12,6	13,8	13	12,2	12	11,8	11,6
December	13,2	12,8	14,0	13,6	12,8	12,4	12,4	11,8
January	13,6	13,2	14,6	13,8	13,4	12,8	13,0	12,4
February	13,4	13,4	14,0	14,2	13,2	13,2	12,6	12,8
March	12,8	13,6	13,2	14,4	12,4	13,6	11,6	13,2
April	12,0	13,8	12,4	14,4	11,8	13,6	11,0	13,4

The blank tests had a different evolution of the soluble dry substance meaning that during the six months of frigorific storage starch was not completely hydrolyzed, consequently the soluble dry substance content increased progressively from one month to another.

At the end of the frigorific storage period, the treated variants have a higher content in soluble dry substance as compared to the blank tests.

Table 3

Evolution of acidity titrated (g a. malic/100g product) fruit during cold storage

Period /variety	**Generos blank**	**Generos treated**	**Stark rimson blank**	**Stark rimson treated**	**Idared blank**	**Idared treated**	**Ionagold blank**	**Ionagold treated**
November	0,56	0,60	0,34	0,38	0,58	0,58	0,52	0,56
December	0,55	0,59	0,30	0,35	0,56	0,57	0,50	0,53
January	0,48	0,53	0,27	0,31	0,44	0,5	0,42	0,46
February	0,40	0,48	0,22	0,27	0,37	0,46	0,35	0,41
March	0,38	0,45	0,21	0,25	0,33	0,39	0,31	0,36
April	0,36	0,39	0,20	0,22	0,27	0,36	0,25	0,33

Throughout the frigorific storage, titrating acidity (tab. 3) had the same decreasing trend for all variety and variants under analysis.

We may notice that the blank tests had a lower content in organic acids as compared to the treated ones, an aspect visible up to the last month of storage.

Table 4

Evolution structuro-textural firmness (UP / 5sec) during cold storage

Period /variety	**Generos blank**	**Generos treated**	**Stark rimson blank**	**Stark rimson treated**	**Idared blank**	**Idared treated**	**Ionagold blank**	**Ionagold treated**
November	25	24	20	20	28	26	27	25
December	28	25	24	21	32	27	30	26
January	33	27	28	26	38	30	34	32
February	38	31	32	30	42	35	39	36
March	40	36	36	33	44	37	41	36
April	42	39	38	37	45	40	43	38

Structo-textural firmness (tab. 4) has amore pronounced downward trend in the first months of cold storage, attributed to more pronounced hydrolysis of starch which has the effect of softening tissues.

Film treatment with CMC was able to maintain good fruit firmness of apple, something seen in all varieties studied.

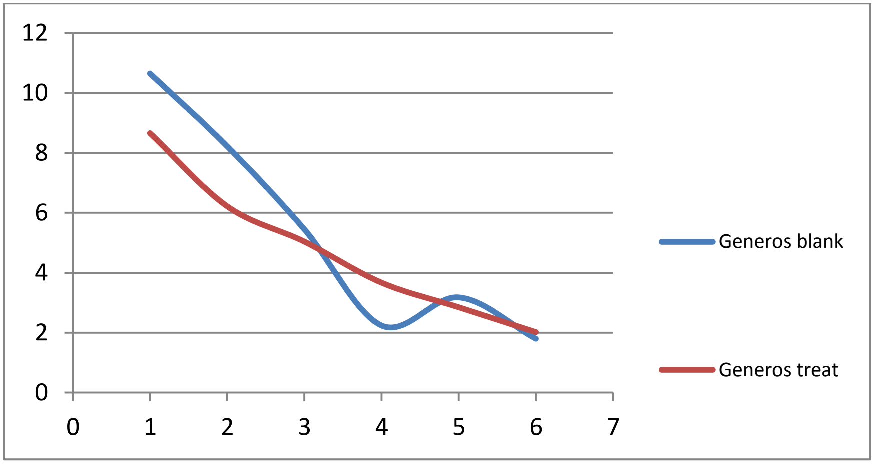

Fig. 1 –Respiration intensity of Generous variety during cold storage

For the blank test of Generos variety (fig. 1), the climacteric phase may be seen ever since February. As the ethylene emission increases, the metabolism of fruits is slightly accentuated in March, but in April metabolism slows down.

In the treated variant, we may notice a decreasing trend of breathing intensity due to the CMC film that partially prevents the gas exchange with the exterior. The metabolism of fruits is slower and slower and fruits do not enter the climacteric phase.

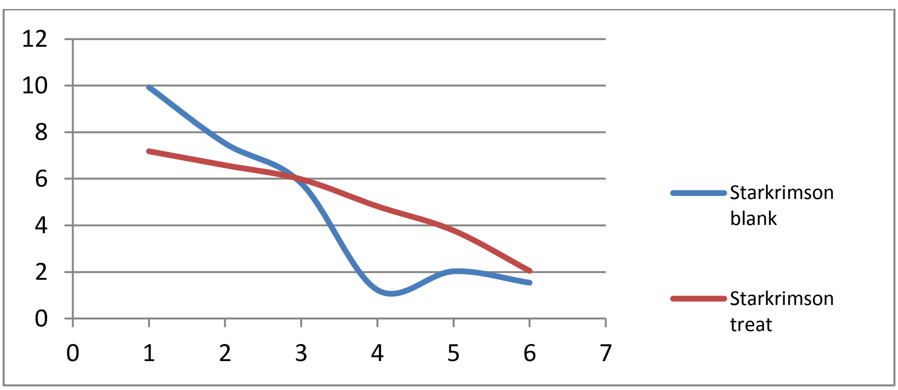

Fig. 2 –Respiration intensity of Starkrimson variety during cold storage

The film slowed down the metabolism of fruits in the first months of frigorific storage (fig. 2), thus the breathing intensity has lower values as compared to the blank test. As for the blank test, we may notice that in February fruits entered their climacteric phase.

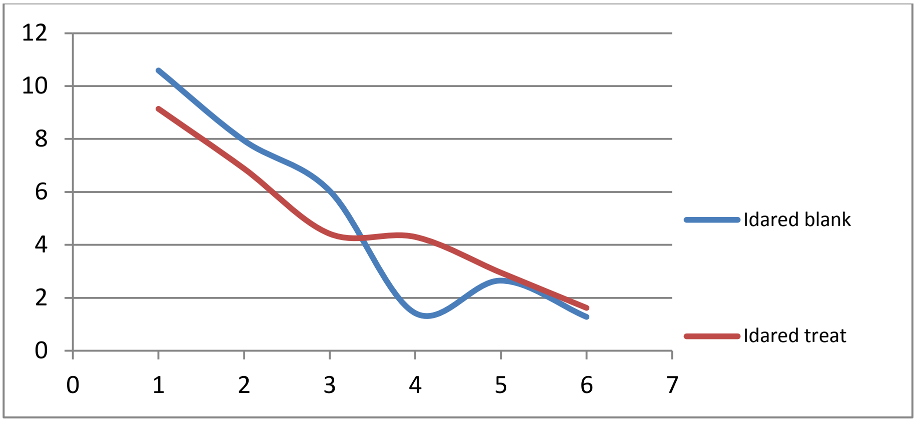

Fig. 3-Respiration intensity of Idared variety during cold storage

The breathing intensity (fig. 3) has a decreasing trend during the period of frigorific storage for all variety and variants under study.

In the fourth month of storage, the apple fruits of the blank test entered their climacteric phase and the abrupt increase of breathing intensity from the next month was due to the higher ethylene emissions finally leading to speeding up of fruit metabolism.

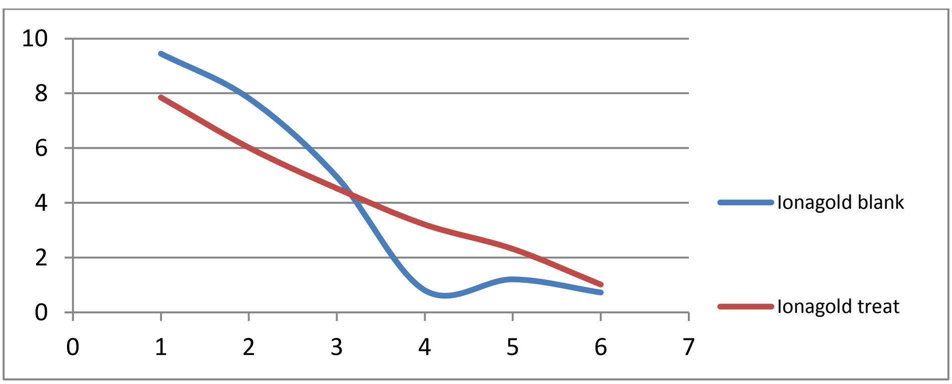

Fig. 4 –Respiration intensity of Ionagold variety during cold storage

In Ionagold variety (fig. 4), the metabolism of treated fruits was lower as compared to the blank test in the first months of storage.

In February, the fruits of the blank test entered their climacteric phase.

CONCLUSIONS

The pellicular treatment with carboxymethyl cellulose shows its efficiency in maintaining the quality of apples during the frigorific storage.

At the end of the storage period, the treated fruits registered superior values as compared to the blank tests both in terms of the content in soluble dry substance and the content in organic acids.

The hydrolization level of starch was more accentuated in the blank tests, whereas in the treated variants we could notice that they still contained this reserve substance.

The structural-textural firmness of fruits from the treated variants was higher due to the decrease of breathing intensity, namely the slowing down of metabolism, and the limitation of gas exchange with the exterior environment.

Considerable differences were registered ever since the first month of frigorific storage both among variety and among variants.

The level of hydrolization of starch was much faster for the blank tests, thus in the first three months the starch reserve was exhausted.

This led to a considerable increase of the content in soluble dry substance followed by an abrupt decrease of this parameter and simple glucides were consumed in the metabolic processes.

At the end of the period of frigorific storage, we may notice a high content in organic acids for the treated variants as compared to the blank tests.

The graphic representation of breathing intensity shows the entry o fruits in the climacteric phase for the blank test in February, whereas in the fruits of the treated variants the decrease of breathing intensity was almost constant without highlighting the climacteric point until April.

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