Список використаних джерел

1. Вітенко І. М. Розвиток ключових компетентностей учнів сучасної школи шляхом проєктної діяльності. Міждисциплінарні інтеграційні процеси у системі географічної та екологічної науки : матеріали Міжнар. наук.-практ. конф., присвяченої 25-річчю відкриття спеціальності «Екологія» у Тернопільському національному педагогічному університеті ім. В. Гнатюка (7–8 травня 2019 р.). Тернопіль : Тайп, 2019. С. 31–34.
2. Власюк І. В. Застосування stem-технології в рамках Концепції Нової української школи для учнів старших класів. Publishing House «Baltija Publishing». February 26–27. 2021. С. 138–142.
3. Нова Українська Школа. Міністерство освіти і науки України. 2016. URL: www.kmu.gov.ua/.../ukrainska-shkola-compressed.pd.
4. Семченко А. А. Організація проєктної діяльності в умовах Нової української школи. Сучасний стан та перспективи розвитку системи освіти України (до 100-річчя Державного вищого навчального закладу «Донецький національний технічний університет»): матеріали Всеукр. науково-практичної інтернет-конференції з міжнародною участю (м. Покровськ, 25 травня 2021 року). Покровськ: ДВНЗ «ДонНТУ», 2021. С. 87–90.
5. Horkavchuk O. Проєктний підхід у вихованні дітей молодшого шкільного віку в контексті Концепції Нової української школи (НУШ). Problems of Engineer-Pedagogical Education. 2018. № 61. С. 65–73.

Anastasiia Blahopoluchna

ANTIMICROBIAL FILMS BASED ON CHITOSANE AS A SAFE STORAGE OF BERRIES

The biggest food losses are due to microbiological damage. Many chemical and physical processes have been developed to preserve the quality of fruits and vegetables. Such processes include pre-treatment of fruit and vegetable raw materials with antimicrobial solutions. Many substances that have previously been treated are considered hazardous, so there is a problem of studying the effects of other substances. Currently, edible films are used that are applied to vegetable and fruit raw materials in thin layers of substances, mostly polysaccharides and oils.

Chitosan is an aminopolysaccharide, a biopolymer with antibacterial properties and widely used in the food industry to control diseases that develop after harvesting and storage of fruit products [1, p. 102]. Chitosan is chemically made from crustacean shells by deacetylating chitin. It consists predominantly of glucosamine or 2-amino-2-deoxyD-glucose linked together by β (1–4) glycosidic bonds. Chitosan solutions are able to form transparent films on the

surface of fruits and berries, which are easily washed off with water, are non-toxic and non-carcinogenic [2, p. 46].

In order to assess the effect of pre-treatment of strawberries with chitosan on microbiological damage during storage, studies were conducted. Strawberries of the Dukat variety were harvested in the fields at the consumer stage of ripeness according to GOST 6828-89, their physical and physicochemical properties were studied, and then they were treated with chitosan solutions, followed by storage.

Strawberries were treated with chitosan solutions of six concentrations (0.05 %; 0.1 %; 0.2 %; 0.3 %; 0.4 %; 0.5 %) by complete immersion for 1 min. Processed berries were left to dry completely. Dried processed berries and controls were weighed and placed in perforated plastic (PET) containers with a capacity of 500 g. Samples were stored in a free-range refrigerator at 0 ± 2 ℃ with a relative humidity of 90–95 %. Uncontrolled berries were considered control.

Sampling and preparation of samples for analysis of fresh strawberries was carried out according to DSTU ISO 874.

All studies were performed in triplicate. The results of the analyzes led to the initial mass by the formula:

$$X = \frac{A \cdot (100 - в)}{100},$$

where: X – content of substances taking into account weight loss, %;

A – content of substances at the end of storage, %;

в – weight loss during storage, %.

In the prototypes were determined:

– the intensity of respiration by the amount of carbon dioxide emitted
– weight loss of berries – by the method of weighing fixed samples;
– gloss – visually on a 5-point scale, where 1 – dull surface of berries, without gloss, and 5 – shiny glossy surface.

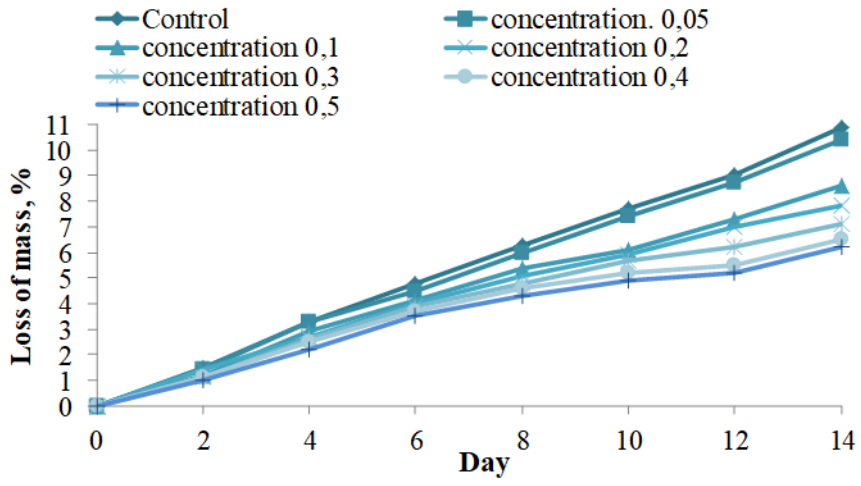

Fig. 1. Change in natural weight loss of strawberries during refrigerated storage with free access of air

The use of pre-treatment of strawberries with chitosan solutions has reduced the weight loss of berries.

The loss of strawberry weight with each day of storage increased and on the second day was 0.98–1.5 %. On the eighth day of storage, the figures ranged from 4.3 to 6.3 %. The lowest losses for the entire storage period were recorded in the sample with a chitosan treatment concentration of 0.5 %. At the end of storage, weight loss reached 9.6 % in controls and 6.2–10.4 % in pre-treated versions.

Analysis of the dynamics of weight loss of strawberries during two weeks of storage showed that treatment with a solution of chitosan helps to reduce weight loss.

The average respiration rate of fresh strawberries was 34.6 mg CO2 • kg/h. On the second day of storage, the indicator decreased sharply regardless of the concentration of storage treatment and ranged from 8.9 to 10.5 mg of CO2 • kg/h. This was facilitated by a significant decrease in temperature to 0 ± 2 ℃. During further storage, the indicators continued to gradually decrease. In the variant treated with 0.5 % chitosan solution, the respiratory rate was the lowest and on the eighth day was 5.3 CO2 • kg/h during storage with free access of air, which is 2.4 less than the control.

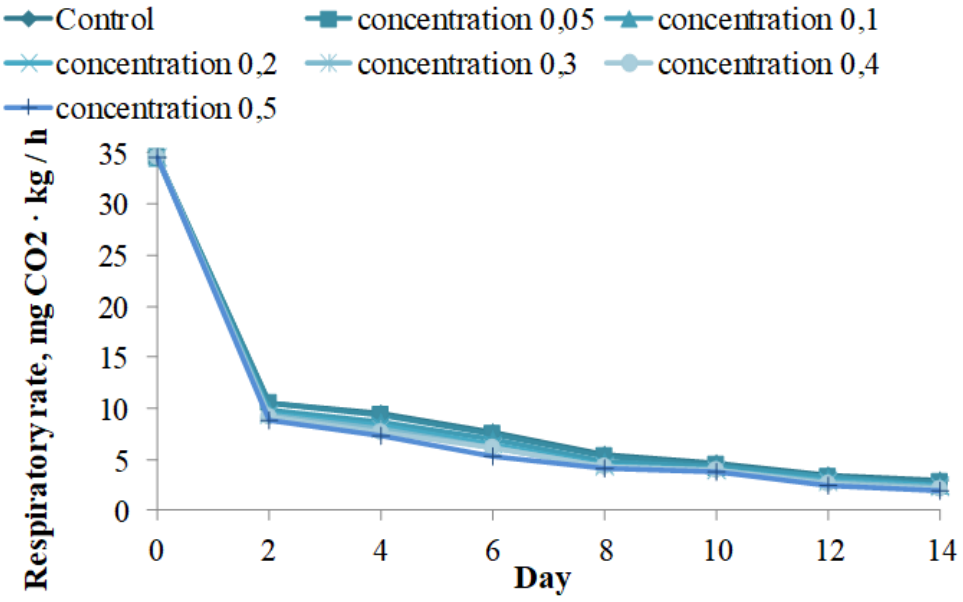

Fig. 2. Change in the intensity of respiration of strawberries during refrigerated storage with free access of air

During storage of strawberries, we recorded rapid rates of gloss loss in the control version (Table 1).

Table 1

Changes in the degree of gloss of strawberries before storage and during storage

Processing concentration,%	Degree of gloss, point		
	For storage	In the middle of the shelf life (7 days)	At the end of storage (14 days)
Control	5	2	1
0,05	5	4	2
0,1	5	5	2
0,2	5	5	3
0,3	5	5	4
0,4	5	5	5
0,5	5	5	5

It was found that due to the film-forming properties of chitosan berries had a shiny glossy surface, which significantly improved the appearance of strawberries. The obtained research results allow to recommend pre-treatment of strawberries with chitosan solutions

Thus, analyzing the results of research, it was found that with increasing the percentage of chitosan in the solution, the loss of strawberry mass and respiration rate decreased, which proves the effectiveness of this treatment. The degree of gloss of the berries was the best in the pre-treated samples.

References

1. Divya K., Jisha M. S. Chitosan nanoparticles preparation and applications // Environmental chemistry letters. 2018. № 16(1). P. 101–112.
2. Kulawik P., Jamróz E., Özogul F. Chitosan for seafood processing and preservation // In Sustainable Agriculture Reviews. 2019. № 36. P. 45–79.

Ольга Бовкун

ФОРМУВАННЯ ЕКОНОМІЧНОЇ СТІЙКОСТІ ТА БЕЗПЕКИ СІЛЬСЬКОГОСПОДАРСЬКИХ ПІДПРИЄМСТВ

Підприємства агропромислового комплексу в умовах ринку займають особливе становище, що не дозволяє в повній мірі брати участь в міжгалузевій конкуренції. Сільське господарство, залежне від природних факторів і має яскраво виражений сезонний характер виробництва, є низько-доходною, більш відсталою в технологічному плані галуззю в порівнянні з іншими галузями і повільніше пристосовується до мінливих економічних і технологічних умов.

Однак, наявність ряду невирішених проблем, зокрема виснаженість