Modern Technologies of Long –Term Storage Depending on the Type of Apple Fruit

Kholmirzaev Ilkhomjon Khasanbaevich
Senior teacher of Tashkent State Agrarian University

Kholikov Akmal Nurmuhammad ugli
Master student of Tashkent State Agrarian University

Ibaydullaev Shuhratjon Boymirza ugli
Master student of Tashkent State Agrarian University

Abstract:
The authors of the article studied the mechanisms of action of bio preparations on the shelf life of bio preparations, created on the basis of new environmentally safety polymer chitosan and its compositions with organic acids to increase the shelf life of apple fruit by type. It has been shown that the optimal media and concentration of preparations and relative humidity are important in the storage of apples.

Key words: chitosan, acetic acid, hydrochloric acid, glycyrrhizic acid, antibacterial, antimicrobial, controlled atmosphere, controlled gaseous environment

INTRODUCTION

In recent years, the global fruit production market has grown by several percent

The annual consumption of each person in the world is 120 kilograms of fruit.

Fruit suppliers include China, the United States, Vietnam, Turkey, Morocco, the European Union, some Asian countries, Iran, Pakistan and India, and others.

According to the data of the last 3 years, food security remains one of the global problems of the world.

At the same time, the leading developed countries of the world (USA, EU countries, Japan, etc.) pay special attention to providing the population with environmentally safe food products.

In these countries, in the process of storage and processing of food products, great attention is paid to the use of preparations derived from natural products, avoiding chemical pesticides[1,2].

Presidential Decree PD -5995 of May 18, 2020" on Development of Organic Agriculture and Production of Organic Food Products of the Republic of Uzbekistan [3].

In the world experience there are different technologies in the process of storing fruits and vegetables.

For example, the following technologies are used for the creation of a gaseous environment and long-term storage of fruits in a controlled atmosphere: -ULO (Ultra Low Oxygen) - storage in the chamber with a very low oxygen content (less than 1-1.5%); - RCA (Rapid Controlled Atmosphere) - technology for rapid reduction of oxygen concentration; - ILOS (Initial Low Oxygen Stress) - an

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ultra-rapid decrease in the level of oxygen in the chamber in a short time; - LECA (Low Ethylene Controlled Atmosphere) - technology to reduce the level of ethylene in the chamber; - DCA (Dynamic Controlled Atmosphere) - dynamically controlled atmosphere; - CO2 shock treatment - shock technology by increasing the concentration of carbon dioxide (up to 30%) [4]

A modified atmosphere is widely used for storage technology.

The gaseous medium is formed by a membrane that selects the gas from the polyethylene film, by inhalation of the raw material (absorption of O2, release of CO2) or by using packages of barrier-type polymer films

In addition, the use of certain antiseptics among storage methods has a negative impact on human health, as it results in long-term storage of fruits.

One of the most promising ways to solve this problem is to create “edible” polymer coatings on the surface of these vegetables and fruits.

The antibacterial and antimicrobial properties of chitosan are widely described in the literature.

Coating the surface of the fruit with a semi-permeable chitosan coating alters the levels of endogenous gases (CO2, O2 and ethylene), impeding aerobic respiration, which represents the bacteriotic and fungistatic effects of this biopolymer.

When apples were treated with the above preparations, their water loss was reduced by 20-40%, depending on the type (table 1)

According to world standards, the new generation of preparations must meet the following requirements: high efficacy; economic efficiency environmental safety.

These requirements increase the relevance of the development of bioavailability, biodegradable natural polymers, including chitosan-based preparations [5., 6., 7., 8., 9.,10., 11.].

The aim of our research is to create preparations based on chitosan, synthesized by deacetylation from silkworm larvae, which is an environmentally safety natural raw material, with the property of increasing the shelf life of fruits. To solve this problem, the use of the optimal composition of the polymer system was chosen: chitosan - organic acid - water-based compositions were made by coating the fruit surface.

In our study, the average molecular weight of analytical pure chitosan was 25,000, the degree of deacetylation was 85 mol%, and acetic, lactic, and dibasic hydrochloric acids were used. In the storage of fruits and vegetables they were processed using solutions and complexes based on organic acids (acetic acid, hydrochloric acid, ascorbic acid, carboxymethylcellulose (KMTs), glycyrrhizic acid, etc.), which are suitable for consumption with chitosan and its derivatives.

Farangiz,Fuji kuki, Namangan krasnaya, Golden super, Golden delicious, Grey smith, Renet semerenko varieties of apples from drupaceous fruits based on the recommended practices for refrigeration of fruits for harvesting process, convenient removal of fruits from field and delivery to refrigerator (protection from mechanical injury), initial cooling of the product (up to 30), long-term storage and refrigeration placement was carried out in order specified in the standerd.

Apple processing of preparations, storage for refrigeration was carried out in accordance with the instructions of UzDst ISO 1212:2010.

Once the fruits are harvested, their maturation (i.e., the activity of various microorganisms, the breakdown of enzymes, loss of moisture (water), and the production of respire ethylene) continues, and as a result, the crop begins to rot.

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If our goal is to store the product, then, depending on the type of product, we need to use the most modern and optimal methods of efficient use of refrigerators to slow down these "ripening" and “decay”(spoiling) processes.

It is known that cold is the main physiological factor that allows to control the ripening process of fruits, and the product has the property of long-term storage at cold temperatures and has been used for a long time.

When harvesting fruits, it is important to know their ripening period, because the quality of the harvested fruit before ripening and after ripening is low and its value is not high.

They have the following periods. 1. The ripening period for the pluck is the end of the process of fruit growth and accumulation of nutrients. Some fruits continue to ripen after being cut. 2. Fruits in technical ripening condition are stored [12]. Experiments were obtained from drupaceous fruits varieties of apples (Malus domestica Borkh) Golden delicious, Golden super, Renet simirenko, Farangiz, Fuju kuki, Gray-smith and Namanganskaya karasnaya varieties.

Each fruit was harvested on the basis of harvesting technology and stored in a refrigerator at +5 degrees for 24 hours, then treated with preparations based on chitosan and its derivatives of different concentrations for long-term storage, and then stored at +1 +3 C, depending on the type of product and laboratory scientific studies were conducted.

The working solutions were prepared by dissolving 0.2% chitosan solution in aqueous solutions of organic acids in a ratio of 1: 1, 1: 2 and 2: 1 for 25 hours at a temperature of 25 ºC.

The surface of the fruit was treated with a polymer coating pH 6.5-6.7, each of the fruits was immersed in a polymer solution for 1 minute and then dried in the open air.

Distilled water was used as a control; the processed fruits were weighed and placed in the refrigerator for storage at a temperature of + 3 ºC and a relative humidity of 90-95%.

The nutritional value of the fruits was assessed visually and organoleptically. Processing results are expressed as a percentage of the weight of spoiled fruit to the total weight of processed fruit at the end of the experiment (percentage of loss) (table 1).

RESEARCH RESULTS ANALYSIS:

As a result of experiments and organoleptic observations, analyses, the optimal concentration of preparations for drupaceous fruits, depending on their navigation, were selected and used in subsequent studies.

The following table shows the preparations used in the storage of drupaceous fruits and the results obtained.

From the above results, it can be concluded that the effectiveness of preparations based on the composition of chitosan with acetic acid in the conservation of the Farangiz variety was high.

At the same time, it was found that the storage was 2.4 to 2.8 times higher than the control.

Experiments have shown that the effectiveness of the chitosan glyceric acid complex was 2.4 times higher.

The results of the experiment show that in the shelf life of the fruits of the new zoning Fuji kuki in Uzbekistan, the efficiency of chitosan and acetic acid-based preparations was 1.7 to 1.8 times higher.

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Table 1: Preparations used in the storage of apple (Malus) varieties and their comparative comparison with control Experiments, temperature -1+2C°,. Relative humidity was carried out at 90-95%.

№	Options set	Types and varieties of apples				
		Storage term of Farangis	% relative to control	% relative to control	Namanganskya krasnaya shelf life	% relative to control
1	Storage term. Control	8	100	100	9 ой	100
2	Chitosan 0,1% acid0,2	19	+137	+75	12	+40
3	Chitosan 0,1%,acetic acid0,1 % (1:1)	20	+150	+78	15,7	+75
4	Chitosan 0,2%+succinic acid 0,25% solution, (1:1)	10,4	+30	+50	9,9	+10
5	Chitosan 0,1% succinic acid 0,1% (1:1)	11,3	+42	+57	10,8	+20
6	Chitosan 0,1%, glycyrrhizic acid 0,01% (1:1)	19	+140	+50	12,6	+40
7	Chitosan 0,2%, glycyrrhizic acid 0,01%	19	+138	+57	11,7	+30

№	Options set	Types and varieties of apples						
		% relative to control	Golden delicious shelflife	% relative to control	Grey smith shelf life	% relative to control	Renet semerenko shelf life	% relative to control
1	Storage term. Control	100	12	100	12	100	11	100
2	Chitosan 0,1% acid0,2	+44	16,8	+40	22	+83	23,1	+110
3	Chitosan 0,1%, acetic acid0,1 % (1:1)	+77	20	+67	21,5	+79	22,6	+105
4	Chitosan 0,2%+ succinic acid 0,25% (1:1)	+33	15,5	+29	12,5	+4	14,6	+33
5	Chitosan 0,1% succinic acid 0,1% (1:1)	+55	18	+50	14,7	+22	15,6	+42
6	Chitosan 0,1%, glycyrrhizic acid 0,01% (1:1)	+50	17,9	+49	21,8	+75	23,9	+118
7	Chitosan 0,2%, glycyrrhizic acid 0,01%	+66	19,5	+63	23,2	93	24,4	+122

Chitosan citric acid was up to 2 times more effective.

The results of the table above show that the effect of preparations of different concentrations of chitosan and its organic acids on the shelf life was not very high (from 0.3 to 0.6 times)

From this, it can be concluded that these prepararions have different effects on the biological processes that take place in the fruit during storage.

Namanganskaya krasnaya variety for Golden Delicious and Golden super varieties, the compositions of 0.1 % to 0.2 % solutions of acetic acid have high effeciency and their effective impact on

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biological processes in fruits was detected.

Experiments have shown that their efficiency was 1.8 to 2.2 times higher than control.

The results obtained in the remaining preparations were observed to be on average 0.3 and 0.6 times higher, respectively.

In high- concentration solutions of chitosan in 1 % and 2 % acetic acid, the shelf life was 2 times shorter than in control, and a negative effect on product quality was observed, similar results were obtained with chitosan 0.2% 0.1 % solutions of ascorbic acid. It was also observed in preparations consisting of 0.1% and 0.25 % solutions.

The highest efficacy in the treatment of the above preparation was found to be 0.5 to 0.8 times higher than the control when treated with preparations of different concentrations formed by chitosan with acetic acid.

This is due to the fact that the secondary maturation period of this variety is short and the skin is thin. In the composition of chitosan formed in high concentrations of acetic acid, preparations based on chitosan ascorbic acid had a negative impact on the apples.

This is explained by the fact that the compositions formed with a highly concentrated soulition of chitosan and ascorbic acid have a strong effect on the thin skin of the apple.

The effect of the preparations listed in the table for the type of Gray Smith in different concentrations of chitosan acetic acid in small concentrations (0.1-0.2%) with acetic acid (0.1-0.2%) and chitosan in 0.01% solutions of glyceric acid the effective effect of the obtained complexes on the shelf life and fruit quality was observed.

Experiments have shown that efficiency increases from 1.5 to 2 times.

The results obtained with other preparations showed almost no change in efficacy or adverse effects on shelf life, especially in high- concentration solutions of chitosan and in the compositions of chitosan and ascorbic acid.

We believe that this is due to the high sensitivity of this variety of apple to reagents.

The Renet simirenko variety of apple is one of the most conventient varieties for storage, as evidenced by the results shown in the table above.

Compositions of chitosan with various organic acids in small concentrations and supromolecular complexes with chitosan glieceric acid increased the storage efficiency by 2.2 to 2.5 times. The effect of the other preparations, especially the compositions with a highly concentrated solution of chitosan and ascorbic acid, was also observed to be weaker than that of other varieties.

We believe that this is due to the thickness of the skin of the apple variety and the strength of the pectin layer.

Thus, based on the results of the above experiments, the optimal concentration of preparation in the storage of apple varieties were selected according to apple varieties and recommendations were prepared on the use of the most effective preparations in the storage of fruits for farms.

CONCLUSION

It can be seen from the table that the composition and concentration of preparation used in their coating have a high effect on the reduction of biological processes in apple fruits during storage.

This, of course, prolongs their shelf life and maintains their quality for a long time.

High results were evident in chitosan and acetic acid complexes of 0.1-0.2%, chitosan and

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glycyrrhizic acid complexes.

The results showed that no significant changes in the composition, physicochemical and mechanical properties of the fruit were observed even when the shelf life was increased by more than 2 times.

Therefore, the above preparations are the most convenient and effective means of preserving apples, and differ from other preparations in terms of environmentally safety.

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