

Indicators of natural decline in storage of fruits of winter pear varieties

Bobosher Nortojoyev^{1*} and *Zikrillo Djabbarov*¹

¹Tashkent State Agrarian University, 100140 Tashkent, Uzbekistan

Abstract. The scientific article analyzed the levels of natural reduction of fruits during the cultivation and storage of pears. It was observed that during storage of pear fruits in non-refrigerated and refrigerated warehouses, the natural reduction levels of fruits were different. Mainly, it was found that there is a big difference in the rate of natural decline of pears when pears are stored in normal refrigerated warehouses compared to pears stored in cold storage.

1 Introduction

Pear is the most common fruit crop after apple, and it is valued for its delicious fruit. Pear fruits are eaten fresh, and they are used to make jam, preserves, sugar syrup, jam, juice, wine. Pears grown in Uzbekistan contain 10.8-12.7% sugar, 0.13-0.30% acids, 0.35% pectin and 0.31% ash [1-5].

All categories of farms in the Republic of Uzbekistan have pear orchards on a total of 8,200 hectares. It is expected to grow 111.9 thousand tons of pears from them. From this, 52.2 thousand tons are harvested from 4.7 thousand hectares in farmers and agricultural enterprises, and 59.7 thousand tons are harvested from 3.5 thousand hectares in residential plots. In 2022, about 1,000 hectares of new pear orchards are being established. 17 varieties of pear are included in the state register of agriculture recommended for planting in the territory of the Republic of Uzbekistan [6-10].

Although the pear is a temperate climate plant like the apple, it requires a lot of heat, is less resistant to cold and lives longer than the apple, living 100-150 years, and sometimes up to 200 years. About 10 local varieties are grown in our conditions. There are about 60 wild species of pears.

As we know, in each region of the Republic of Uzbekistan, the period of ripening of seed fruits and pears differs in certain aspects due to the climatic conditions and geographical location of this region. There is a specific harvest time for pear varieties of different ripening periods. For example, in the foothills of the Tashkent region, the harvesting period for pear varieties ripening in the summer season is carried out in the first-second decade of August, for autumn varieties in the second decade of September, and for winter varieties - in the third decade of September, in the first decade of October [10-19].

* Corresponding author: tds.bio@mail.ru

2 Materials and Methods.

GOST 33499-2015 international standard for determining the quality indicators of pears during storage, ISO/GOST 2173-2013 standard for dry matter content of pears, GOST 56820-2015 standard for pears storage in refrigerated warehouses, determination of vitamins in pears GOST 25999-83 standard, mono- and disaccharides, organic acids, pectin substances contained in pear before storage and after storage - by carbazole method; organoleptic assessment of pears by tasting them according to the GOST 8756.1 standard, FFV-51 requirements for certification and control of pear quality, developed by E.P.Shirokov and V.I.Polegaev for the evaluation of the quality of fruits and vegetables in determining the coefficients of importance in the organoleptic analysis of products of the methods, in the analysis of the biochemical composition of pear fruits, it was carried out on the basis of the methodical guide "Methods of biochemical research of plants" by A.I.Ermakova.

3 Results and Discussion

Studies have shown that attention has been focused on identifying new pear cultivars with biologically determined shelf lives that help reduce storage losses of pears. In order to evaluate the storage quality of winter pear fruits, we analyzed the main indicators of the storage quality of the fruit and studied them during our experiments. The state of pear fruits for storage and the quality of goods after storage, physiological processes and resistance to microbiological disturbances during storage, dynamics of biochemical changes were studied and analyzed.

In this case, the storage stability of pear fruits and the quality indicators of fruits after storage were analyzed. It was found that pear winter varieties were stored in a normal warehouse and in a refrigerated warehouse, and when we compared them, they differed in several aspects. Mainly, when pear fruits are stored in ordinary warehouses, due to the fact that it is not possible to artificially ensure the temperature and relative humidity of the air in the structure, it was observed in our experiments that the physiological processes that take place in the fruits during the rest period are accelerated and the biochemical changes in the fruit content take place a lot faster.

It was found that even when the autumn varieties are technically ripened, the level of sugar content in the fruit is accelerated due to external environmental factors. That is, if we take into account that the daily temperature is 28-30 °C even during the technical ripening of autumn varieties, it is known that the influence of the general daily temperature on the level of fruit ripening is large (Table 1).

Table 1. Quality indicators of fruits of winter varieties of technically ripened pears after two months of storage (2020-2022).

Options	Temperature °C	Air Relative Humidity %	Pear varieties	Quality indicators of fruits after storage %					Tasting grade in 5 points
				I type	II type	III type	non-standard	rotten	
non-refrigerated warehouse (control)	14-16	56-60	Zimnyaya nashvati	76,2	10,1	8,3	4,5	0,9	4,1
			Royal zimnaya	74,6	11,2	9,2	4,7	0,8	4,2
refrigerated storage warehouse	4-6	80-85	Zimnyaya nashvati	91,1	4,1	2,4	2,1	0,3	4,6
			Royal zimnaya	90,2	4,4	2,7	2,3	0,4	4,7

In the case of winter varieties, as the technical ripening period coincides with September, it was observed that the daily temperature is much lower. This situation directly affects the delay in the level of fruit ripening. Therefore, the level of technical, edible and biological ripening of winter pear varieties is slow. In our experiments, it was observed that there were differences in the activity and metabolism of biochemical processes taking place in winter varieties in the period of technical ripening and in the rest period.

The experiments showed that when we stored winter pear varieties in normal warehouses and refrigerated warehouses, compared to the control (normal warehouse), several differences were observed. The process of changes in fruits before and after storage was analyzed.

When pear fruits are stored in ordinary warehouses, the air temperature is 14-16 °C, and the relative humidity of the air is 56-60%. When the pear fruits are stored for two months and analyzed, the percentage of fruits of the I type of the pear Zimnyaya nashvati was 76.2%, while the percentage of fruits of the II type was 10. It was observed that the indicators of III types of fruits were 8.3%, non-standard fruits were 4.4%, and unusable (rotten, rotten) fruits were 0.9%. The Zimnyaya Nashvati variety of pear was given a tasting rating of 4.1 points by experts.

In the Royal zimnyaya variety of pear, the percentage of fruits of I type was 74.6%, and fruits of II type were 11.2%. It was observed that the indicators of III types of fruits were 9.2%, non-standard fruits were 4.7%, and unusable (rotten, rotten) fruits were 0.8%. Royal zimnyaya variety was given a tasting score of 4.1 points by experts.

In our experiments, it was observed that Zimnyaya nashvati variety of winter varieties of pear stored in ordinary warehouses had slightly higher shelf life and post-storage indicators than Royal zimnyaya variety in ordinary warehouses.

When pears are stored in refrigerated warehouses, the air temperature is 4-6 °C, and the relative humidity of the air is 80-85%. When the pears are stored for two months and analyzed, the percentage of fruit yield of the I type of pear was 91.1%, while the percentage of II type of pears was 91.1%. It was 4.1 percent. It was observed that the indicators of III type of fruits were 2.4%, non-standard fruits were 2.1%, and unusable (rotten, rotten) fruits were 0.3%. The Zimnyaya nashvati variety of pear was given a tasting rating of 4.6 points by experts.

In the Royal zimnyaya variety of pear, the percentage of fruits of I type was 90.2%, while the percentage of fruits of II type was 4.4%. It was observed that the indicators of III type of fruits were 2.7%, non-standard fruits were 2.3%, and unusable (rotten, rotten) fruits were 0.4%. Royal zimnyaya variety was given a tasting rating of 4.7 points by experts.

Winter varieties of pears stored in refrigerated warehouses, Zimnyaya nashvati and Royal zimnyaya varieties did not differ significantly from each other in their indicators after storage.

Experiments have shown that when pears are stored in ordinary warehouses, as a result of the acceleration of physiological processes, the rest period of fruits is shortened and the period of biological ripening is accelerated. Rapid changes were observed in the morphological characteristics of the fruit, the color of the fruit skin, the density of the fruit flesh, the smell of the fruit, and the state of the fruit band.

When pears were stored in cold storage for two months, no significant changes were observed in the fruits, due to the fact that the temperature and relative humidity of the cold warehouse were suitable for the storage of the fruits. As a result of this, it was found that pear fruits remained stagnant, weight loss and changes in fruit composition were relatively low. It is worth mentioning that during the storage of pear fruits, it was observed during our experiments that the quality and marketability indicators of the fruit are preserved due to the relative reduction of the physiological processes that take place in the fruits during the rest period.



Figure 1. a) state of storage of pear fruit for two months in an ordinary warehouse, b) the state of pear fruit being stored in a refrigerated warehouse for two months

When the fruits of pear winter varieties were stored in cold storage, it was found that microbiological spoilage losses were very low after the fourth month and until the end of storage. It is worth mentioning that winter pear varieties have a high shelf life of Zimnyaya nashvati and Royal zimnaya pear varieties when the temperature is 4-6 °C and the relative humidity is 80-85%.

During the storage of winter pear varieties in normal storage warehouses and cold warehouses, when the condition of small grains in the skin part of the fruits was analyzed under a microscope, it was observed that the biological changes of these grains were significantly different from the changes in the skin of the fruits stored in the normal storage warehouse, and the changes in the skin of the fruits stored in the refrigerated warehouses. It was observed that the fruit grains were enlarged and changed from brown to dark brown color (Figure 2).



Figure 2. a) small grains in the mesocarp of pear fruit after two months of storage in a normal storage warehouse, b) small grains in the mesocarp of pear fruit after two months of storage in cold storage

It is worth mentioning that it was found that pear fruits retain their quality and market value after two months when stored in refrigerated warehouses. Mainly, when pear fruits

are stored in ordinary warehouses, as a result of the acceleration of physiological processes in the fruits, along with the changes in the composition of the fruit, several morphological indicators of the fruit peel were found to change dramatically.

During the storage of fruits, the environment in the warehouse contains physiological, microbiological and active substances, hydrolysis, that is, the formation of various compounds (acids, bases, etc.) as a result of interaction between substances and water, including ion exchange reactions (in salts). Hydrolysis is an important process that is widespread in inorganic and organic compounds, and is known from scientific sources to occur in salts, carbohydrates, proteins, esters, fats, and compounds of various classes.

The water molecule in the fruit consists of two hydrogen and one oxygen atoms, and due to the combination of these atoms, an equilibrium is formed between the ions of salts of weak acids and bases. Acids and bases are concepts that appear in general chemistry and analytical chemistry, and hydrolysis is arguably one of the simplest chemical reactions out there. The general equation for hydrolysis is ($AB + H_2O = AH + B-OH$).

Changes in biochemical processes in pear fruits during storage, this type of reaction has a special place when it comes to biomolecules. Therefore, the bonds that hold the monomers of the molecules are prone to hydrolysis under certain conditions. That is, it is observed that the covalent bonds to which the molecules are attached are broken in the presence of water. An example of this is fruit sugars. Sugars in fruit are able to hydrolyze polysaccharides to break them down into monosaccharides. We know from scientific sources that this occurs due to the action of enzymes called glucosidases.

Thus, it was determined that Zimnyaya nashvati and Royal zimmaya varieties have the best storage stability among the studied winter pear varieties. It was observed in our experiments that the fruits of this pear variety rot, the percentage of non-standard fruits, minimal losses and high indicators of first-grade fruits allow the fruits to preserve their marketability characteristics and quality indicators when these varieties are stored in cold storage.

This type of reaction has a special place when thinking about biomolecules that change the biochemical processes in the composition of pear fruits during storage. Therefore, the bonds that hold the monomers of the molecules are prone to hydrolysis under certain conditions. That is, it is observed that the covalent bonds to which the molecules are attached are broken in the presence of water. An example of this is fruit sugar. Sugars in fruit are able to hydrolyze polysaccharides to break them down into monosaccharides. We know from scientific sources that this occurs due to the action of enzymes called glucosidases.

4 Conclusion

When the fruits of winter varieties of pears are stored in refrigerated warehouses, after four months and until the end of storage, microbiological deterioration and losses are very low. Zimnyaya nashvati of pears and Royal zimmaya varieties have high shelf life.

When pear fruits are stored in refrigerated warehouses, the air temperature is 4-6 °C, and the relative humidity of the air is 80-85%. When the product is stored for four months and analyzed, the yield percentage of pears of the Zimnyaya nashvati variety was 91.1%, while the percentage of fruit yield was 91.1%. II type fruits was 4.1%. The indicators of III type fruits were 2.4%, non-standard fruits were 2.1%, and unusable (rotten, damaged) fruits were 0.3%.

Reference

1. Abduvasikov, A., Khurramova, M., Akmal, H., Nodira, P., Kenjabaev, J., Anarkulov, D., Kosimova, S., Xurshida, K., Dildora, M., Sapaev, B., Sullieva, S., & Kurbonalijon, Z. The concept of production resources in agricultural sector and their classification in the case of Uzbekistan. *Caspian Journal of Environmental Sciences*, **22(2)**, 477-488 (2024). Doi: 10.22124/cjes.2024.7740
2. Atkhamova, S., Eshmatov, F., Fayzullaeva, N., Shomaksudova, K., Uzakova, S., & Zokirov, K. Determination of bioactive compounds of pomegranate peel to incorporate as a functional food ingredient in food production. *BIO Web of Conferences*, Vol. **95**, 01038 (2024). <https://doi.org/10.1051/bioconf/20249501038>
3. Azizov, A. S., Sultonov, K. S., & Gafurov, J. A. Scientific significance of using protective devices in pear storage in refrigerated warehouses (in the case of Uzbekistan). *IOP Conference Series Earth and Environmental Science*, **939(1)**, 012039 (2021). <https://doi.org/10.1088/1755-1315/939/1/012039>
4. Buriev, K., & Zokirov, K. Seasonal and daily blooming rhythm of cucumber (*Cucumis sativus*) belonging to Cucurbitaceae family. *E3S Web of Conferences*, Vol. **452**, 01015 (2023). <https://doi.org/10.1051/e3sconf/202345201015>
5. Buriev, K., & Zokirov, K. Seasonal and daily blooming rhythm of watermelon (*Citrullus lanatus*) belonging to Cucurbitaceae family. *E3S Web of Conferences*, Vol. **452**, 01014 (2023). <https://doi.org/10.1051/e3sconf/202345201014>
6. Buriyev, Kh., Jorayev, J., & Alimov, A. Storage and preliminary processing of fruits and vegetables, *Tashkent* (2002).
7. Dissanayake, K., Rifky, M., Farmonov, J., Boynazarova, Y., Meyliyev, A., Zokirov, K., & Samadiy, M. Impact of incorporating inorganic additives in processed meat production. *E3S Web of Conferences*, Vol. **510**, 01037 (2024). <https://doi.org/10.1051/e3sconf/202451001037>
8. Dissanayake, K., Rifky, M., Hunupolagama, D., Harris, J. M., Zokirov, K., Azizova, K., & Samadiy, M. Inorganic additives in meat production and processing. *E3S Web of Conferences*, Vol. **510**, 01028 (2024). <https://doi.org/10.1051/e3sconf/202451001028>
9. Krivorot, A. Forecasting the timing of harvesting and keeping quality of Belarusian apple fruits. *Abstract of Cand. Sci. (Agricultural Sciences)* (1998).
10. Mirsaidov, M., Nimchik, A., Khodjiyev, O., Jesfar, M., Zokirov, K., Shamatov, S., & Kambarov, A. Analysing the chemical standards of the Fergana Mekhmash wastewater treatment plant and environmental processing. *E3S Web of Conferences* Vol. **498**, 02016 (2024). <https://doi.org/10.1051/e3sconf/202449802016>
11. Mozhar, N. Assortment of pears and its dynamics. *Improvement of assortment and technical conditions of pears: Abstract of report and presentation at scientific-method conference*, Orel, 12-15 (1997).
12. Odinayev, M., Buriev, K., Sultonov, K., & Eralieva, S. Analysis of mechanical properties, biochemical composition and technological parameters of grape (*Vitis*) raisin varieties in conditions of Uzbekistan. *E3S Web of Conferences*, **284**, 03023 (2021). <https://doi.org/10.1051/e3sconf/202128403023>
13. Poligaev, V. Storage of fruits and vegetables. 252 (1982).
14. Rifky, M., Abdusalomova, D., Dissanayake, K., Zokirov, K., Harris, J. M., Jesfar, M., & Samadiy, M. Seaweed as a functional ingredient and emulsifier in dairy processing.

BIO Web of Conferences, Vol. **108**, 18001 (2024).
<https://doi.org/10.1051/bioconf/202410818001>

15. Sedova, Z. Characteristics of new pear varieties by chemical composition of fruits. *Improvement of assortment and technology of pear cultivation: Abstract of report. and presentation, on scientific-method, conference*, Orel, 12-15 (1997).
16. Shaumarov, Kh., & Islamov, S. "Technology of storage and primary processing of agricultural products". *Tashkent* (2011).
17. Shirokov, E. Workshop on technology of storage and processing of fruits and vegetables. *Agropromizdat*. 192 (1985).
18. Sultonov, K., Fayziev, J., Eralieva, S., Vakilova, S., & Temurov, T.. Effect of mineral fertilizers on increasing productivity and quality of seedless varieties of grapes. *Lecture notes in networks and systems*, 1930–1940 (2023). https://doi.org/10.1007/978-3-031-21219-2_215
19. Zokirov, K., & Sullieva, S. Effect of storage conditions and periods on the quality of watermelon (*Citrullus lanatus*). *E3S Web of Conferences*, Vol. **452**, 01016 (2023).
<https://doi.org/10.1051/e3sconf/202345201016>