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Effective Method of Apple Storage

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Abstract: In the storage of apple varieties such as Grenny Smit, Skarlet, Pinklady, Golden delishes, Fuji treated with the Smart Fresh preparation combined with the controlled atmosphere (CA), the laws of preservation of the quality indicators of their fruits have been determined. The application of SmartFresh has been shown to be highly effective in maintaining better firmness, juiciness, appearance and taste of apples.

Keywords: apple, storage, smartfresh, hardness, ethylene, controlled atmosphere, commodity analysis, biochemical parameters.

Introduction. It is challenging to plan long-term storage utilizing high-efficiency technologies in order to supply fruit goods to the people of our country throughout the year. The ripening of the fruits after harvesting must be slowed down in order to prolong shelf life, maintain quality, and lower losses. Ethylene, a molecule that is emitted from fruits that speeds up ripening, must be lessened during storage in order to achieve this.

Using SmartFresh, which slows down the ripening process by sealing ethylene receptors and lowering the strength of its release, is a promising technique to maintain the marketability of apples during storage. Apple tissues' strength and sugar content can be maintained by storing apples using SmartFresh (SF) post-harvest treatment in combination with a controlled environment (BA). This allows for more intensive maintenance of the processes necessary for respiration and ethylene production. Apples that are late in ripening might have a shelf life of 6-7 months.

The purpose of the research. It entails researching and evaluating the effects of processing several apple kinds under controlled conditions (BA) while using the Smart Fresh medication. A significant contributor to apple ripening, aging, and the emergence of numerous physiological illnesses in its fruits is ethylene (the ripening hormone). After the fruit has been processed, the molecules of the active ingredient 1-MCP firmly connect to the ethylene receptors in the cell membrane, taking its place. This is how the ethylene inhibitor works. As a result, ethylene is unable to attach to receptors and create functional complexes that quicken the ripening and aging of fruit. 1-MCP has a ten times stronger affinity for receptors than ethylene. It has been demonstrated that treating apple fruits with Smart Fresh 1-methylcyclopropene (1-MCP) can considerably reduce losses and preserve fruit quality by delaying the ethylene synthesis, ripening, and aging processes.

Methodology. The study focuses on apples cultivated in the "Marokand fruit and vegetable" cluster in Jomboy district of Samarkand region, specifically Granny Smith, Scarlet, Pinkledy, Golden Delishes, and Fuji. The water-filled generator was used to combine the SmartFresh formulation in soluble sachet form. The end result was used to treat apple fruits. Due to air movement in the chamber, the drug's cyclodextrin base disintegrated, releasing 1-MCP gas and delivering it to the

fruits. Fruits were kept in an airtight environment for 24 hours, after which the chamber was aired for 30 minutes. The fruits were then kept there in the usual manner. Experimental storage "Isolcell" refrigerator made in Italy and atmosphere controlled by LLC in subnormal environment (containing 1.5% O2) and 1.5% CO2) were conducted. Refractometric, titrimetric, photometric analysis methods were used to determine the optimal level of fruit ripening and biochemical parameters during storage:

Soluble dry substances according to GOST 29030-91;

Total sugar according to GOST 8756-13.87;

Titratable acids according to GOST ISO 750-2013;

hardness of apple core with penetrometer FT-372;

Production of varieties according to GOST R 54697-11;

GOST 34151-2017- determination of vitamin C.

Result discussion. Granny Smith, Scarlet, Pinkledy, Golden Delishes, and Fuji apple cultivars were processed using SmartFresh in order to preserve the initial quality indicators of harvested fruits as much as possible and to lessen damage from the physiological disease of apples "rust." After six months of storage, fruit that had been treated with SmartFresh and stored in a controlled environment had 96% high value fruit. (Table 1)

Table 1. Product yield % of fruits treated with SmartFresh preparation for Granny Smith apple variety, (storage period - 6 months)

Apple quality (variety)	SmartFresh and BA	Control
High grade	96	75
1 variety	4	15
Non-standard	0	8
Rotten	0	2

Fruits' metabolism is greatly slowed down by the SmartFresh medication, preserving their high quality and organoleptic qualities. The fruits continued to be juicy, rich, crisp, and beautiful even after six months of storage. The regulated environment and SmartFresh fruit handling both slow down ethylene generation and lessen its detrimental effects on fruit quality during storage.

The difference between the versions was from 1.1 to 2.2 kg/cm^2, which had a substantial impact on taste evaluation. In addition to the fruit's flavor being kept, the drug's maximal effect on keeping the firmness of the apple core was also noted after 6 months of storage. The core hardness of Granny Smith apples after six months of storage in the control form was 7 kg/cm^2, while it was 8.6 kg/cm^2 in the experimental variant. The fruits of the Scarlet, Pinklady, Golden, and Fuji varieties showed similar outcomes (Table 2).

Table 2. Change in hardness of apples treated with SmartFresh preparation, kg/cm ^{2}

Apple variety	Before storing	Control	Processed
Granny Smith	12,5	7	8,6
Scarlet,	9,5	6	9,1
pinkled,	10,5	7	9,5
Golden delicacies	10,0	6	8,5
Fuji	11,0	7	9,0

An significant benefit of preserving fruits that have been picked and processed using the SmartFresh preparation in a controlled environment is the elimination of natural weight loss (up to 2 percent), which prevents apples from drooping even when kept for a long time. Thus, after 6 months of storage, fruits naturally lose 5-1% of their weight (Granny Smith, Golden delights) and up to 1.5% of their total weight in experimental samples (Fuji varieties). 3% (variety Granny Smith, Scarlet) and

up to 4% in the control group (variety Fuji). The amount of starch, soluble solids, sugars, acids, and vitamins in the fruit will determine how the fruit will change in quality during storage.

The strength of metabolic processes is correlated with changes in the solids and sugar content of apples. SmartFresh post-harvest treatment during fruit storage slows the ripening process, as shown by the experimental variant's slower sugar increase compared to the control's faster accumulation of sugar from starch breakdown. So, during storage, the dry matter content of Granny Smith apples was 11%. The dry matter content rose to 13% in the control after six months of storage and to 12.4% in the SmartFresh post-harvest processing option. The shift in total titratable acids is a crucial sign of fruit ripening speed and quality. During storage, regardless of the method used to store the fruit, the acid level in all tested apple kinds drops, which lowers the "acid content to sugar content ratio". sweetness of fruit (sugar-acid index). Fruits treated with the medication often had 15% more acid retention (Table 3).

Table 3. Changes in biochemical quality indicators of apple fruits during storage

Variant	QMM, %	Total sugars, %	Total acidity, %	Sh/k index	Vitamins, mg/100 g	
					C	P
Granny Smith						
Fresh	11,5	9,0	1,02	8,9	9,0	121,0
Stored for 6 months						
Control	13,0	9,3	0,75	12,5	7,2	93,2
Processed	12,5	8,8	0,89	10,1	8,1	111,2
Scarlet						
Fresh	12,5	8,5	0,76	12,9	13,0	102,3
Stored for 6 months						
Control	13,9	9,5	0,66	18,2	8,2	81,5
Processed	12,9	8,8	0,71	13,5	10,0	91,6
Pinkled						
Fresh	13,0	9,0	0,66	12,4	12,6	100,5
Stored for 6 months						
Control	13,8	9,2	0,56	14,5	9,0	86,4
Processed	12,8	8,8	0,61	11,0	11,5	96,8
Golden delicacies						
Fresh	13,2	8,1	1,02	8,1	8,5	118,5
Stored for 6 months						
Control	12,0	9,7	0,76	11,5	7,3	91,5
Processed	12,9	9,0	0,90	10,8	8,0	110,4
Fuji						
Fresh	11,5	8,4	0,65	13,4	13,1	105,0
Stored for 6 months						
Control	12,8	9,2	0,50	18,4	8,8	85,9
Processed	11,8	9,0	0,62	14,6	10,2	100,2

During storage, the vitamin content also declines. When apples were stored for six months, vitamin P's value declined by ten to fifteen percent, and vitamin C's value decreased by twenty to thirty percent since it decomposes the most quickly. The storage of vitamins in the experimental versions was also revealed to be 10–20% higher than in the control thanks to the application of storage technology and the SF medication. Fruits should keep their great quality not only while being stored, but also when being delivered to the consumer. After being placed in coolers and for a long time after the fruit is sold, apples stored in low-oxygen environments occasionally lose their quality prematurely (brown peel, etc.). This is because when the chamber is opened, the environment's oxygen content increases dramatically, physiologically leading to "sunburn." causes the disease to spread quickly. Granny Smith SmartFresh treatment of the fruit guarantees protection against apple

skin bruising when stored for six months in a controlled environment. Fruits treated with SmartFresh maintain their resistance to physiological ailments even after they are delivered to the consumer.

Conclusion. Thus, after 6 months of storage, fruit quality indicators, including fruit pulp, of several apple kinds increased when fresh-picked apple fruits were treated with the SmartFresh preparation and stored in a regulated atmosphere (O2 concentration 1.5% and CO2 1.5%). It was discovered that it exhibits promising outcomes in keeping hardness. The suggested method gives consumers access to high-quality fruits and extends the shelf life of apples to 7-8 months.

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