Volume 3, Issue 3, March - 2025
ISSN (E): 2938-3781

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

STUDY OF THE EFFECT OF WRAPPING APPLE VARIETIES WITH DIFFERENT PAPER BAGS ON THE CHEMICAL COMPOSITION DURING THE VEGETATION PERIOD

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Abstract
This study investigated the effect of wrapping apple fruits in different paper bags during the growing season on their chemical composition. The use of paper bags during fruit ripening affects their appearance, biochemical composition, and environmental safety. Using different paper materials (paraffined, mediated, natural), the content of antioxidants, the concentration of phenolic compounds, and the sugar content were analyzed. The results showed that the use of paper bags helps reduce pesticide residues on the skin of fruits and extend their shelf life. At the same time, changes in the balance of oxygen and carbon dioxide in the fruit were observed due to the effect of some paper bags on gas exchange. This study reveals the possibilities of effective use of paper bags in the production of environmentally friendly and safe fruits.

Keywords: Apple varieties, paper bags, appearance, antioxidant content, phenolic compounds, ecologically clean, safe, fruit flowering.

Introduction

In countries with developed horticulture, extensive scientific research has been conducted and is currently continuing to produce abundant and high-quality fruit products from fruit trees that are ecologically clean and protected from mechanical influences of the external environment [1-5].

As a result of scientific research on the application of various paper bags to apple fruits, the scientific works of Fan X., Mattheis J.P. [2], Zhu Z. [3], Teixeira R., Boff M.I.C., Amarante C.V.T.D. and others [4], Wang X., Hang B., Liu C. [5] are commendable. They examined the direct and indirect effects of paper bags on modern intensive apple varieties. In particular, it was emphasized that the composition of the fruits can be influenced by affecting the biological characteristics of apple varieties.

In Uzbekistan, the issues of growing fruit crops protected from various external harmful factors have been considered within the framework of a scientific project, and the study of the impact of the chemical composition of fruits has been poorly conducted. At the same time, the change in the chemical composition of fruits over time requires the use of environmentally friendly technologies that allow the production of high-quality and export-oriented products (low sugar content, high acid content) at the expense of changing the ripening period.

That is why in our study, we showed that it is possible to grow not only beautiful and attractive

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fruits, but also those with high-quality fruit content, by covering the fruits of four varieties of apples found in intensive orchards with different types of paper bags, paying attention to changes in their growth and development, and the chemical composition of the fruits.

The experiments were conducted at the Academician M. Mirzaev Research Institute of Horticulture, Viticulture and Winemaking. The fruits of modern intensive apple varieties Williams Pride, King David, Stakrimson and Mutsu were used in the experiment. In this case, the fruits of each variety were not treated in the control variant 10-15 days after flowering. In the first variant of the experiment, the fruits of each variety were covered with a two-layer white paper bag (WQQ). In the second variant, the fruits were covered with a two-layer yellow paper bag (SQQ). In the third variant, the fruits were covered with a paper bag with a gray outer side and a black inner side (QQQ) (see Figure 1).

Figure 1. Paper bags used in the experiment: I – two-layer white paper bag, OQQ; II – two-layer yellow paper bag, SQQ; III – paper bag with a gray exterior and a black interior, QQQ.

The fruits were evaluated for their appearance throughout their development. All varieties of fruit were harvested at maturity. Freshly picked fruits were left in a cool room for 1-3 days, after which aliquots were taken from each sample for analysis. The dry matter content of the fruits was determined by drying them in a thermostat until they were completely dry, that is, until a constant mass was formed. In addition, the sugar content of the fruits was measured using a refractometer. The acid content of the fruits was determined in the laboratory. The sugar-acid index was calculated by dividing the total sugar content by the acidity content.

According to the results of the experiments, when using paper bags in modern apple varieties, changes are observed in all chemical elements of the fruit. In particular, we can see that the dry matter content of the fruit in all varieties was higher in the control variant, that is, in the case when the fruits were not covered with bags. At the same time, there were practically no differences in the quantitative indicators of dry matter. Thus, the dry matter content of the fruit in all variants of paper bags decreased steadily. The lowest indicator was observed in fruits with a gray outer side and a black inner side (Table 1).

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Table 1 The effect of paper bags on the chemical content of apple fruits, %

Varieties / Bag	Williams Pride		King Devid		King David		King David	
	Quantity Naz. ratio	Naz. nisb.	Quantity. Naz. ratio.	Quantity. Naz. ratio.	Quantity. Naz. ratio.	Quantity. Naz. ratio.	Quantity. Naz. ratio.	Quantity. Naz. ratio.
Dry matter content								
Naz.	15,3	100	16,9	100	18,5	100	17,6	100
OQQ	15,0	98,0	16,4	97,0	18,0	97,3	17,1	97,2
SQQ	14,7	96,1	15,9	94,1	17,3	93,5	17,0	96,6
QQQ	14,0	91,5	15,7	92,9	17,0	91,9	16,8	95,5
Sugar content								
Naz.	12,8	100	11,0	100	12,5	100	12,7	100
OQQ	12,1	94,5	10,7	97,3	12,0	96,0	12,0	94,5
SQQ	11,3	88,3	10,4	94,5	11,9	95,2	11,7	92,1
QQQ	10,9	85,2	10,0	90,9	10,5	84,0	10,1	79,5
Total acidity								
Naz.	0,6	100	0,7	100	0,5	100	0,5	100
OQQ	0,6	103,3	0,8	114,1	0,6	119,1	0,6	123,5
SQQ	0,7	109,8	0,9	122,5	0,7	146,8	0,7	139,2
QQQ	0,8	137,7	0,9	125,4	1,1	234,0	1,3	254,9
Glycemic index								
Naz.	21,0	100	15,5	100	26,6	100	24,9	100
OQQ	19,2	91,5	13,2	85,3	21,4	80,6	19,0	76,5
SQQ	16,9	80,4	12,0	77,2	17,2	64,8	16,5	66,2
QQQ	13,0	61,8	11,2	72,5	9,5	35,9	7,8	31,2

Since the sugar content of the fruit is inversely related to the total acidity, in all varieties the sugar content was lower in paper bags, while the acidity of the fruit in the paper bag variants increased by up to 2.5 times (in the Mutsu variety) compared to the control. Similarly, the sugar-acid index in the Williams Pride variety was 21.0 in the control variant, 19.2 in the second variant, 16.9 in the third variant, and 13.0 in the fourth variant, respectively. King In the David variety, the indicators were as follows: 15.5 (control); 13.2 (OQQ); 12.0 (SQQ) and 11.2 (QQQ). In the Stakrimson variety, the indicators were 26.6 (control); 21.4 (OQQ); 17.2 (SQQ) and 9.5 (QQQ). In the Mutsu variety, the indicators were 24.9 (control); 19.0 (OQQ); 16.5 (SQQ) and 7.8 (QQQ). It is not difficult to see that the indicators dropped sharply in the last two varieties. This shows that the fruits in paper bags are characterized by a relatively sweet or semi-sweet taste.

In conclusion, the dry matter and sugar content of apples packed in paper bags decreases, and the acid content of the fruits increases. As a result, in the cultivation of export-oriented apples, it is important not only to obtain fruits with a uniform appearance and light color, but also to obtain fruits with a low sugar content in the pulp.

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