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Analysis of changes in fruit density under different transportation methods

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Abstract. This article examines changes in the density of fruit in packaging during different transportation methods from warehouse to supermarket. To clarify the indicators of changes in the density of fruits with different methods of transportation from warehouse to supermarket, in this study, an analysis was carried out of changes in the density of fruits in packaging for three delivery methods: in boxes up to 10 kg, in boxes up to 30 kg and in boxes up to 50 kg. The results of the study are relevant for further research in the field of improving the preservation of fruit quality during the delivery process, as well as for conducting new research in the field of ecology and agriculture.

1 Introduction

Changing the quality of agricultural products, including fruits, is an urgent scientific problem. The average percentage of fruit loss due to a drop in their quality during transportation can reach 10-15%, which results in multimillion-dollar losses for modern agricultural corporations.

Analysis of changes in the density of fruit in packaging during different methods of transportation from the warehouse to the supermarket can be carried out using three delivery options:

- in boxes up to 10 kg;
- in boxes up to 30 kg;
- in boxes up to 50 kg.

2 Materials and Methods

To identify changes in the density of fruits in packaging with different methods of transportation from warehouse to supermarket, this study analyzed changes in the density of fruits in packaging for three delivery methods (Table 1).

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Table 1. Analysis of changes in the density of fruit in packaging during different methods of transportation from warehouse to supermarket.

Method No.	Delivery method
No. 1	In boxes up to 10 kg
No. 2	In boxes up to 30 kg
No. 3	In boxes up to 50 kg

For the purposes of collecting and processing data, analyzing changes in the density of fruits in packaging for different methods of transportation from warehouse to supermarket, various methods were considered [1-30].

3 Results and Discussion

3.1 Results of the analysis of changes in the density of fruit in packaging for different methods of transportation from the warehouse to the supermarket (with three delivery methods: in boxes up to 10 kg, in boxes up to 30 kg and in boxes up to 50 kg)

3.1.1 Measuring changes in the density of fruit in packaging during different methods of transportation from warehouse to supermarket (method No. 1)

The results of measuring changes in the density of fruit in packaging with different methods of transportation from the warehouse to the supermarket using method No. 1 are presented in Figure 1.

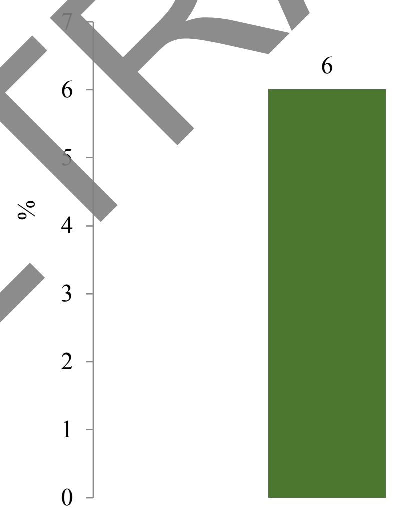

Fig. 1. Results of measuring changes in the density of fruit in packaging for different methods of transportation from a warehouse to a supermarket using method No. 1.

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3.1.2 Measuring changes in the density of fruit in packaging during different methods of transportation from warehouse to supermarket (method No. 2)

The results of measuring changes in the density of fruit in packaging with different methods of transportation from the warehouse to the supermarket using method No. 2 are presented in Figure 2.

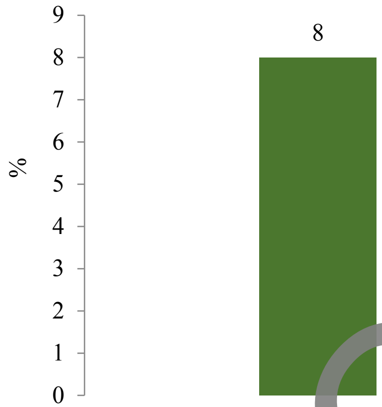

Fig. 2. Results of measuring changes in the density of fruit in packaging during different methods of transportation from the warehouse to the supermarket using method No. 2.

3.1.3 Measuring changes in the density of fruit in packaging during different methods of transportation from warehouse to supermarket (method No. 3)

The results of measuring changes in the density of fruit in packaging with different methods of transportation from the warehouse to the supermarket using method No. 3 are presented in Figure 3.

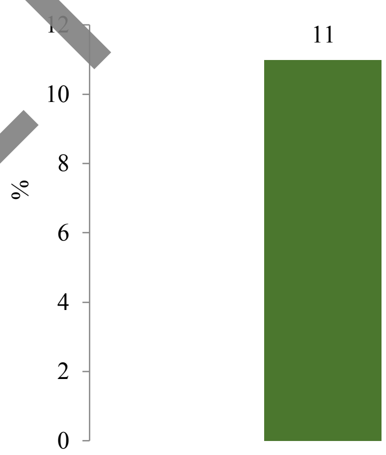

Fig. 3. Results of measuring changes in the density of fruit in packaging during different methods of transportation from the warehouse to the supermarket using method No. 3.

To process the data, analysis of changes in the density of fruit in packaging with different methods of transportation from the warehouse to the supermarket, formulas 1, 2 and 3 were used.

$$SS_{fact} = \frac{\sum_j^p T_j^2}{n} - \frac{(\sum x_i)^2}{N} \quad (1)$$

$$SS_{total} = \sum x_i^2 - \frac{(\sum x_i)^2}{N} \quad (2)$$

$$M = \frac{X_1 + X_2 \ \dots + X_i}{n} \quad (3)$$

Processing of the results, analysis of changes in the density of fruit in packaging with different methods of transportation from the warehouse to the supermarket confirmed the Gaussian distribution of data regarding changes in the density of fruit in packaging with different methods of transportation from the warehouse to the supermarket.

3.2 Discussion

The obtained results of changes in the density of fruits in packaging with different methods of transportation from the warehouse to the supermarket allow us to conclude that such an influence exists.

The average change in the density of fruit in packaging for different methods of transportation from warehouse to supermarket is shown in Figure 4.

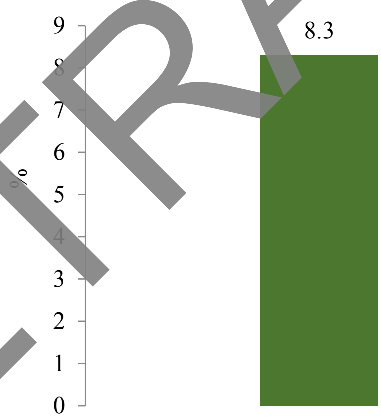

Fig. 4. The average indicator of measuring the change in the density of fruit in packaging during different methods of transportation from the warehouse to the supermarket.

4 Conclusions

The conducted study presents data on changes in the density of fruit in packaging during different methods of transportation from the warehouse to the supermarket. To identify changes in the density of fruit in packaging with different methods of transportation from warehouse to supermarket, this study analyzed changes in the density of fruit in packaging for three delivery methods: in boxes up to 10 kg, in boxes up to 30 kg and in boxes up to 50 kg. The results of the study are relevant for further research in the field of improving the preservation of fruit quality during the delivery process, as well as for conducting new research in the field of ecology and agriculture.

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