USC 664.64.016/.761
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THE EFFECT OF STORAGE CONDITIONS ON THE QUALITY OF WINTER WHEAT GRAIN

Grain storage is the final stage in the grain production process. It is difficult to store grain without losses or a decline in quality, because grain is a living organism and provides a favorable environment for the growth of microorganisms, diseases, mites, and rodents. Preserving the grain's high sowing and processing properties until the time of use is possible only under optimal storage conditions. The essence of the storage regime lies in creating and consistently maintaining such environmental conditions and such a state of the grain mass that physiological activity is minimized and the main factors leading to grain spoilage cannot manifest themselves. In global practice, the following grain storage conditions are used: 1) in a dry state; 2) in a cooled state; 3) without air access. When selecting a storage condition, it is necessary to consider grain moisture content, temperature, air access, climatic conditions, the economic feasibility of the condition, and other factors.

Taking into account the foregoing, research on the impact of storage conditions on the quality of winter wheat during storage is relevant and of practical interest.

The research was conducted in the laboratory of the Department of Storage, Processing, and Standardization of Plant Products named after Prof. B. V. Lesik at the National University of Life and Environmental Sciences of Ukraine. Grain quality parameters were determined in triplicate. Winter wheat grains of the varieties 'Myronivska 65' and 'Poliska 90' were used for the studies. Wheat grain of the experimental varieties was stored under two conditions: 1. in a cooled state (5–10°C); 2. in a dry state (control). The focus of the study was the quality of wheat grain from the experimental varieties during long-term storage under different storage conditions.

The following technological parameters were determined in the experimental wheat grain samples: 1. moisture content; 2. specific weight; 3. vitreousness; 4. gluten content; 5. gluten quality; 6. falling number.

The primary factor determining the direction and intensity of physiological and biochemical processes during grain storage is its moisture content. The grain was placed in storage with a moisture content of 13.0–14.2%. During storage, the grain's moisture content fluctuated, but these changes did not exceed critical values. Smaller fluctuations in moisture content were observed during storage in a cooled state. In a dry state, during storage in a conventional grain storage facility, fluctuations in moisture content occurred, which is explained by temperature fluctuations and variations in relative air humidity under unregulated storage conditions.

Grain moisture content affects its specific weight, as confirmed by a high correlation coefficient averaging 0.84. As grain moisture content increases, its specific weight decreases, and conversely, it increases as moisture content decreases. Higher quality values and smaller fluctuations in these values were observed during refrigerated storage, as grain moisture content is lower under these conditions and remains more stable throughout storage.

The results indicate that the vitreousness of the winter wheat samples was quite low – 20–38%. No significant changes in the proportion of vitreous grains were observed during the storage period. A slight increase in grain vitreousness was observed at the beginning of storage, during post-harvest ripening, but not in both varieties. The increase in this indicator is due to biochemical processes and the formation of more complex substances (proteins, fats). Overall, it can be noted that neither the storage conditions nor the duration of storage affected the change in the vitreous index.

The results of the studies showed that the falling number, which characterizes the amylolytic activity of wheat grains, varies among different varieties.

The falling number in both experimental samples of winter wheat grain had fairly high values of 259–320 s. Due to these high falling numbers, both wheat grain samples exhibited relatively poor baking properties. The bread is pale, heat-resistant, and of low volume. This grain requires an increase in the activity of amylolytic enzymes through the addition of enzyme preparations.

It should be noted that, on average, the falling number is higher when stored in a dry state (control) than when stored in a cooled state. Furthermore, this parameter is more stable when grain is stored in a cooled state.

The quantity and quality of gluten depend on the variety and growing conditions (climatic zone, soil type, weather and climate conditions, preceding crop, irrigation zone, and fertilization system).

N. S. Berkutova and I. A. Shvedova assert that during the post-harvest ripening process, both in the first 30 days after harvest and in the subsequent period (2–3 months), the gluten content does not change significantly. In our studies, the increase in gluten content during this period amounted to a maximum of 1.1%. The quality of raw gluten improved; it became more elastic. During storage, gluten quality improved under uncontrolled conditions for up to 6 months, but with further storage, gluten strength decreased by 2.0 units of gluten strength compared to the previous storage period, whereas under controlled conditions, it continued to improve for up to 12 months.

Thus, the studies conducted indicate that the main quality parameters of winter wheat grain im-

prove significantly during the first months of dry storage (control group) compared to storage under cooled conditions.

It is advisable to store winter wheat grain with moisture content within the critical range and good initial quality indicators in a dry state for no more than 9 months; for longer storage periods, such grain should be stored in a cooled state. Under this storage regime, quality indicators are more stable and undergo fewer changes.

USC 631.563.9:633.111:631.526.3
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THE GLUTEN QUALITY OF WINTER WHEAT GRAINS DEPENDS ON STORAGE CONDITIONS AND VARIETAL CHARACTERISTICS

Determining gluten quality in Ukraine, unlike in other regions of the world, is of critical importance. This is because the harmful grain weevil is very widespread in Ukraine, causing damage to up to 20% of the grain in some years. The maximum permissible damage level is 2–3%.

Gluten quality is characterized by its physical properties—toughness, extensibility, elasticity, water absorption and gas retention capacity.

Winter wheat grains of the varieties 'Poliska 90', 'Natsionalna', 'Smuglyanka', 'Podolyanka', 'Myronivska 65', and 'Perlyna Lisostepu' were studied. The wheat grains were stored for 12 months in an uncontrolled environment (in warehouse conditions) and under controlled temperature conditions (at 5–10°C) in linen bags.

This study employed previously established methods for assessing wheat grain quality that are most commonly used in industrial practice and scientific research.

Based on gluten quality, the samples of the studied varieties can be conditionally divided into two groups. Samples in Group A ('Smuglyanka', 'Poliska 90', 'Myronivska-65'), which had 101–105 units on the VDK instrument, and Group B ('Podolyanka', 'Perlyna Lisostepu', 'Odeska 267') with 82–90 units on the VDK instrument. Gluten quality varied during storage.

Grain samples of Group A varieties strengthened their gluten during storage under controlled conditions for up to 12 months by 4.7 units on the VDK scale, under uncontrolled conditions for up to 9 months, and during further storage, the gluten weakened by 1.7–2.0 units on the VDK scale compared to the previous storage period. In grain samples of Group B varieties, gluten strength increased by 9 units on the VDK scale over 12 months under controlled conditions, while under uncontrolled conditions, gluten strength increased for up to 9 months and subsequently decreased by 2.0–3.7 units on the VDK scale.

The gluten quality of the Group B grain samples was suitable for bread baking, and further storage was not recommended. The quality of grain with weak gluten improved during storage under controlled conditions, and its quality consequently increased.

The gluten quality in flour, compared to that in grain, increased slightly by an average of 4 units on the VDK scale. The change in the quality of flour gluten during the storage of soft winter wheat varieties of Group A under controlled conditions strengthened slightly and gradually from 96 units on the VDK scale to 94 units on the VDK scale by the 6th month, and in the following months, it weakened slightly compared to the previous ones (by 1.0–1.3 units on the VDK scale). Under uncontrolled conditions, during the first months of storage, gluten strength increased by an average of 3 VDC units over 2 years, followed by a decrease of 0.7–1.7 VDC units compared to the first month of storage.

In flour made from Group B wheat varieties, gluten strength increases slightly and gradually under uncontrolled conditions, and by the 12th month of storage, it had increased by 5.3 units on the VDK scale. In storage, gluten strength increased by 4.7 units on the VDK scale during the first month and remained unchanged thereafter. Gluten quality in flour was stronger compared to grain, averaging 4.7 units on the VDK scale for Group A and 2.0 units on the VDK scale for Group B.

Thus, based on our research, it can be concluded that storing grain with weak gluten – provided the grain is not damaged by the shell bug – should be carried out under controlled temperature conditions, while grain with strong gluten can be stored in a silo, as this is more cost-effective.