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**INFLUENCE OF QUALITY INDICATORS OF WINTER WHEAT GRAIN  
ON BAKING PROPERTIES OF FLOUR****ВПЛИВ ЯКІСНИХ ПОКАЗНИКІВ ЗЕРНА ПШЕНИЦІ ОЗИМОЇ НА  
ХЛІБОПЕКАРСЬКІ ВЛАСТИВОСТІ БОРОШНА****Varabolia O.V. / Бараболя О.В.***s.ag.s., as.prof. / к.с.-г.н., доц.*

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**Abstract.** *The article substantiates the relevance of a comprehensive assessment of a number of indicators of grain and flour quality, in order to determine the nutritional value of bakery products made from them. The aim of the study is to determine the impact of the quality of flour obtained from soft winter wheat grain and to identify differences depending on the variety, to investigate and establish the peculiarities of flour, their impact on the baking properties of flour. The analysis of the influence of varietal properties on the chemical composition of winter wheat grain was carried out according to the following indicators: gluten content, falling number, protein content, sedimentation number. The wheat variety directly affects the baking properties of flour, because it has different technological properties. The investigated samples showed quite acceptable results for further use in production. Thus, we have identified two varieties – Zelenyi Hai and Lyutenka, which showed the best results in all parameters and indicators. The identified research results provide an opportunity to understand what baking products will look like, what you need to pay attention to in order to improve the quality of bakery products and increase productivity.*

**Key words:** *winter wheat, grain quality, baking properties, flour quality.*

**Formulation of the problem.** One of the most important conditions for increasing the yield and quality of wheat grain is the creation of stable in productivity varieties with high adaptability and wide agroecological plasticity. Grain quality is one of the most difficult selection traits, which is determined by both genotype and growing conditions. To predict the success of selection, it is important to know the ratio of genotypic and phenotypic components of each of the traits [5].

When creating varieties, all the selected features are of great importance, but those that characterize the quality of grain get a special one. According to breeders, a variety has no right to exist if it is not able to form high-quality grain [4, 5].

Numerous studies have shown that the natural potential of varieties and solving the problem of its implementation largely depends on the eco-adaptive approach to the selection of varieties for certain agroclimatic zones, subzones, microzones and farms with different specializations and resource opportunities. After all, very often new varieties find themselves in inappropriate conditions, which causes insufficient realization of their genetic potential.

Among the main factors are the weather conditions of the year, because it takes more than 80 % of the total share of all factors influencing the formation of productivity. In recent years, a new climate has formed in Ukraine. This is noticeable



by many hydrometeorological signs and indicators. Winters are warmer and less snowy now, springs have become colder, and summers are with sharp fluctuations in temperature – from cool to heat and vice versa. But the fact that the average annual air temperature rises and there is a risk of drought, forces to adapt and grow intensive, highly productive and drought-resistant varieties.

Looking at the data from the State Register of Plant Varieties that are suitable for distribution in Ukraine, in recent years it can be noted that the grain quality of more than one hundred varieties of winter wheat are strong, more than fifty are valuable. As the modern world does not stand still and promotes the development of new technologies and the emergence of new samples, breeders are working on varieties that could be attributed to strong wheat [14]. In the past, Ukrainian wheat had a world fame due primarily to the high content of crude gluten (35–40 %) [9].

Considerable attention is paid to determining the parameters of grain quality from the very beginning of selection work with wheat. One of the oldest indicators of grain quality, which is still widely used in determining the grade of grain, is the natural weight and vitreousness [2, 7]. The leading role in determining the baking quality of flour belongs to proteins, the content of which in wheat grain depends on the variety and growing conditions of the crop and averages 9.0–15.0 %. Among wheat proteins, albumins, globulins, gliadins, glutenins are distinguished depending on their ability to dissolve in water, salt solutions, alcohol and alkalis. Albumins and globulins include enzymes, structural proteins, proteins of cell walls and membranes, cell organelles, etc. [6]. The content of protein and gluten in the grain is closely related to the nutritional value of bread and baking properties of flour [7].

But there is a decrease in the quality of gluten with increasing its content [11]. There is evidence of both a positive correlation between protein and gluten content with flour strength [8] and a lack of association [4, 10]. The protein content in the grain is characterized by a low degree of inheritance compared to other signs of quality [3]. The strength of the flour is one of the most informative among the quality indicators [7].

**The aim of the article** is to determine the impact of the quality of flour obtained from soft winter wheat grain and identify differences depending on the variety, to study and to establish the characteristics of flour, their impact on the baking properties of flour.

**Results and discussion.** When determining the quality of winter wheat grain in the laboratory of quality there were obtained results, taking into account varietal characteristics and properties. Quantitative quality indicators were derived on average after conducting experiments according to generally accepted methods for clearer selection of the variety. Samples of winter wheat grain were taken from the 2018–2019 harvest.

The weight of 1000 grains is one of the main economic indicators. Its calculation is carried out in order to reliably determine the seeding rate of grain, because without these calculations it will be impossible to establish seeding rates and determine germination in the field. Among the studied samples, the highest size is 48.0 g and belongs to the variety Zelenyi Hai. The lowest weight of 1000 grains was observed in the variety Orzhytsia, which is 8.3 g less and is 39.7 g.



The vitreousness of the grain is a feature that characterizes the structure of the endosperm of the grain, its consistency. It is related to the variety, cultivation conditions and chemical composition. There are vitreous grain, partially vitreous and floury. For the most part, vitreous grains contain more protein than flour. The vitreousness is an important indicator of grain quality, because it characterizes certain technological properties of the grain itself, its purpose. The vitreous flour has the best baking properties. Among the above studied samples, the highest vitreous index has the variety Zelenyi Hai. And the variety Orzhysia, having not too high indicators of weight of 1000 grains and germination, was distinguished by a high percentage of vitreousness, which is 96 %. Analyzing the obtained research results (Table 1), we can say that these varieties are the best for baking bakery products according to the above indicators. The lowest vitreous index belongs to the Poltavchanka variety and is only 70 %.

**Table 1**

**Influence of varietal properties on the weight of 1000 grains and vitreous grain size of winter wheat, 2018–2019**

Variety	Weight of 1000 grains, gr	Vitreousness, %
Orzhysia	39,7	96
Poltavchanka	40,1	70
Tsarychanka	42,2	78
Zelenyi Hai	48,0	97
Karmelyuk	40,8	80
Ariyivka	42,1	91
Lyutenka	42,1	94
Sagaydak	41,3	81
Dykanka	42,2	85

*Author's research*

Today, when determining the quality of cereals, the level of gluten is one of the most important values, as it significantly affects the quality of flour. Gluten is a fraction of wheat protein that can be washed out of flour, i.e. it is a chemical substance of the protein group that is insoluble in water. It determines the volume of bread and the thickness of the dough. This substance is very important in the manufacture of bread and pastries. The more gluten in wheat, the higher the quality of grain.

The data in table 2 indicate that the highest content of gluten has a variety of Lyutenka with a rate of 37 %. Varieties with the lowest indicators are Orzhysia (30 %), Dykanka (31 %) and Zelenyi Hai (31 %). Qualitative indicators of bread products depend on DGD (determination of gluten deformation). A special DGD device measures the gluten deformation index. There are three groups of DGD: the first group has indicators of 45–75 units, the second – 80–100 units, the third – 105–120 units. The best indicators of gluten content are considered to be 45–75 units, which characterizes the first group. In the studied varieties of wheat the second group prevails and the indicators range from 88 to 102 units.

The falling number reflects the value of the activity of the substance alpha-amylase, which characterizes the baking properties of flour and shows that the starch



grains are not damaged – not mechanically or as a result of premature germination. The lowest indicators, which are prescribed in State Standard, are two marks: for the highest and the first grade of flour – not less than 185, for the second grade – not less than 160. If the falling number is lower than these marks, the bread from this flour will have a sour taste and will depart from the crust. However, high rates of falling number are not a guarantee of tasty and high-quality bread and indicate that the activity of wheat's own substances is reduced. And this is an important guarantee for a quality fermentation process. Among the wheat grains presented in the study (Table 2), there were indicators from 206 (which is acceptable) to 452 (which in this case is an increased figure, so the final quality of bakery products may not be the best).

**Table 2**

**Influence of varietal properties on the chemical composition of winter wheat grain, 2018–2019**

Variety	Gluten content		Falling number	Protein content, %	Sedimentation number, ml
	Gluten quantity, %	DGD, units			
Orzhytsia	30	90	366	13,6	55
Poltavchanka	36	94	433	16,3	61
Tsarychanka	32	90	428	14,8	60
Zelenyi Hai	31	88	383	14,0	51
Karmelyuk	32	95	379	14,7	50
Ariyivka	32	102	206	14,5	34
Lyutenka	37	98	410	16,9	50
Sagaydak	33	97	406	15,0	55
Dykanka	31	95	452	14,1	57

*Author's research*

The protein content characterizes not only the nutritional value of grain, but also its technological properties. In quality grain, this quality indicator should be at the level of eleven to seventeen percent, because at lower or higher values, the quality of bakery products made from the flour of this wheat deteriorates sharply. After conducting research in the quality laboratory, it was noticed that all 9 varieties of winter wheat meet recognized standards. The lowest indicator of protein content is 13.6 %, which has the variety Orzhytsia, and the highest is 16.9 % in the variety Lyutenka.

The sedimentation number is a measure to assess the ability to swell and the quality of the protein complex of the grain. Indicators to focus on are: low – below 16 ml, high – more than 47 ml. Among the samples presented in table 2, most of them belong to the high – more than 50 ml and more. Only one sample of Ariyivka winter wheat grain has an average of 34 ml.

As known, bread and wheat flour dough by its nature is a complex system in which the processes of hydration, swelling, structure formation, peptization of proteins, which play a crucial role in shaping the structural and mechanical properties of the dough. Flour proteins are able to bind large amounts of water, mostly osmotically, and they swell strongly and form an internal gluten frame in the dough.



The strength of this frame depends on the amount of gluten and its quality, which determines the elastic properties of the dough, its consistency, as well as gas-holding capacity, which, along with gas-forming, determines the volume of bread, the structure of its crumb. In recent years, bakery enterprises in Ukraine receive flour with low gluten content, which significantly impairs its baking properties [1].

The process of baking bread samples consisted of several stages: preparation and dosing of raw materials, kneading the dough, its fermentation, forming, processing, proofing, baking, cooling. During the preparation of raw materials, flour was selected and sifted, sugar and salt were dissolved and yeast was diluted. The batch was carried out by steaming according to the standard recipe in compliance with the established doses of raw materials.

In the sponge method, the dough is prepared in two phases: preparation of the sponge and preparation of the dough. To make the sponge take about half of the total amount of flour, about two-thirds of water, the entire amount of yeast. The duration of fermentation of the sponge is 3...4.5 h at the initial temperature of 28...32 °C. The readiness of the sponge is determined organoleptically (from pressing on the surface of the sponge it begins to fall) and by acidity and volume, which increases by 1.5...2 times. To the prepared sponge add the rest of the flour and water, as well as salt, mix everything thoroughly to a homogeneous consistency. Fermentation lasts from 1 to 2 hours at an initial temperature of 28...32 °C. During the fermentation period, the dough from high-quality flour is interrupted once or twice. The bread is baked for 20...30 minutes at a temperature of  $230 \pm 5$  °C. To ensure optimal humidity in the oven put a metal vessel with water. Baked bread is stored until the next day in such a way as to prevent it from drying out or fogging or shrinking [13, 15].

Before baking bread, samples of winter wheat grain were selected and examined. Having obtained the results, a table with indicators of baking properties was compiled, from which it is noticeable that all the studied samples have a good baking potential (Table 3).

**Table 3**

**Organoleptic evaluation of bread baked from flour of the studied samples of winter wheat**

Variety	Поверхня хліба			Indicators of crumb quality				Total score, point
	Surface of crust	Shape of crust	Colour of crust	Sponginess	Elasticity	Colour	Taste, smell	
Orzhytsia	5	4	5	5	5	4	4	4,6
Poltavchanka	5	5	5	5	5	5	5	5
Tsarychanka	5	4	5	3	4	3	4	4
Zelenyi Hai	4	5	5	3	4	3	5	4,1
Karmelyuk	5	4	5	5	4	3	4	4,3
Ariyivka	2	3	4	3	4	3	4	3,3
Lyutenka	3	4	4	3	5	3	4	3,7
Sagaydak	5	4	5	3	4	3	4	4
Dykanka	5	4	5	5	5	5	5	4,9

*Author's research*



The quality of wheat bread is determined by the volume yield, appearance (shape, surface character and color of the crust), sponginess, elasticity and color of the crumb, taste, smell, and shape stability of the bread [15]. The quality of the obtained bread was assessed by organoleptic method, ie with the help of human senses (sight, hearing, touch, taste). It allows you to determine the appearance, taste, smell, color, structure, consistency, degree of grinding (Table 3).

The main requirements for bread are [15]:

- the shape of the bread can be domed, oval, semi-oval, flat, concave;
- the surface of the crust can be smooth, uneven, hilly, hard, with cracks, explosions or without them;
- the color of the crust can be pale, yellow, golden-yellow, golden-brown, light brown, pale with a gray tinge, gray;
- the sponginess of the crumb can be small, thin-walled, uniform, uneven, thick-walled, large;
- elasticity of the crumb – it can be elastic, which quickly restores shape from finger pressure, inelastic, insufficiently restores the shape, inelastic, which poorly or not at all restores the shape;
- the color of the crumb can be white or white with yellow, gray shades, light or light with the same shades, dark gray, dark, dirty yellow;
- the taste of bread should be characteristic of wheat, non-sour, unleavened, unsalted, without signs of bitterness, foreign taste and crunch;
- the smell of bread should be characteristic of wheat, not have musty and other foreign scents.

After analyzing the baked bread, it was found that all samples have a satisfactory quality score. The best total score belongs to the winter wheat variety Poltavchanka (5 points out of 5 possible according to generally accepted standards). We obtained the following results: the crust was smooth, glossy, domed, golden-brown. As for the crumb, it is elastic, quickly regains its shape, is white in color, has a fine, thin-walled, uniform sponginess and has a pleasant, wheat-specific smell.

The bread baked from winter wheat flour of the Ariyivka variety has a cracked crust surface (2 points), a semi-oval shape (3 points), and a light brown color (4 points). The crumb is inelastic, restores shape well (4 points), has a moderately large, uniform sparseness (3 points), is light in color with a gray tinge (3 points), has a specific smell of wheat bread (4 points).

**Conclusions.** Studies have shown a relationship between the quality of winter wheat grain and its varietal characteristics. The wheat variety directly affects the baking properties of flour, because it has different technological properties. The investigated samples showed quite acceptable results for further use in production.

The bread made from winter wheat flour of the Poltavchanka variety has the best characteristics among the studied samples. The lowest assessment of baking properties belongs to bread made of winter wheat flour of the Ariyivka variety. To improve the taste and physical characteristics of bread, you can resort to the method of mixing flour with better performance.



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**Анотація.** У статті обґрунтовано актуальність здійснення всебічної оцінки низки показників якості зерна і борошна, з метою визначення харчової цінності виготовлених з них хлібопродуктів. Метою дослідження є визначити вплив якості борошна, отриманого з зерна пшениці м'якої озимої та виявити відмінності залежно від сорту, дослідити та встановити особливості борошна, їх вплив на хлібопекарські властивості борошна. Аналіз впливу сортових властивостей на хімічний склад зерна пшениці озимої проводився за показниками: вміст клейковини, число падіння, вміст білка, число седиментації. Безпосередньо сорт пшениці впливає на хлібопекарські властивості борошна, бо має різні технологічні властивості. Досліджені зразки показали досить прийнятні результати для подальшого застосування на виробництві. Отже, нами виділено два сорти – Зелений гай і Лютецька, які показали найкращі результати за всіма параметрами і показниками. Виявлені результати дослідження дають можливість зрозуміти, якими будуть продукти випікання, на що потрібно звернути увагу для досягнення покращення якості хлібобулочних виробів та збільшити продуктивність.

**Ключові слова:** пшениця озима, якість зерна, хлібопекарські властивості, якість борошна.

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