European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 02, 2020

UDK 664.8
BAKING PROPERTIES AND QUALITY EXPERTISE WHEAT FLOUR

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Abstract: This article presents the results of a study of samples of flour from wheat grains of varieties Yuna, Kupava. Their baking properties, the state of protein-proteinase and carbohydrate-amylase complexes were determined. It has been found that flour from Yuna wheat has good baking properties. The results of the examination of the quality of flour for organoleptic, physicochemical and safety indicators were carried out.

Keywords: gluten quality, sugar-forming ability, gas-forming ability, water absorption capacity, baking properties, quality examination, toxic elements, mycotoxins, flour defects.

1. Introduction:

One of the tasks of increasing the well-being of the people is their high-quality nutrition, optimally balanced in terms of the content of individual nutrients, their physiological and energy value. The daily, widespread and nationwide consumption of bread products gives reason to consider them food products of paramount importance.

An extremely important problem for the bakery industry is the high quality and nutritional value of bread and bakery products. The determining factor in the quality of the latter are the properties of flour as the main recipe component. The analysis of the baking properties of flour makes it possible to predict the quality of flour products, predetermines the choice of the main parameters of the technological process and creates the preconditions for obtaining high-quality products even from substandard flour. The dominant influence on the course of the technological process and the quality of flour products is exerted by indicators characterizing the baking properties of flour, namely, the state of its protein-proteinase and carbohydrate-amylase complexes [1,2].

The object of the study was samples of wheat flour of varieties Yuna and Kupava, representing various agricultural regions of the Bukhara region of the Republic of Uzbekistan. The reference sample was the flour of a milling mixture of grain from different varieties of wheat, obtained under the production conditions of a mill.

Under laboratory conditions, the grain of the studied wheat varieties was milled on a mill of the MLU-202 Buhler type. Of four grain samples of each wheat variety, a grinding mixture was made up in an amount of 200 kg. If the flour yield did not correspond to 70% (based on the finished product), then additional sifting was carried out from the grinding systems on a laboratory sieving with a sieve No. 38 for 10 minutes. All the remaining streams were directed to the bran. The resulting flour was weighed and samples were taken for analysis.

2. **Materials and Methods**:

Evaluation of the baking properties of flour was carried out according to the results of a study of the state of its protein-proteinase and carbohydrate-amylase complexes, test laboratory baking, which characterizes the properties of the dough and the quality of bread.

The state of the protein-proteinase complex of flour was judged by its "strength", determined by the amount of gluten and its rheological properties (Table 1).

Table 1

Indicators of protein-proteinase complex of flour

№	Indicators	Control	Grain wheat flour	
			Yuna	Kupava
1	Mass fraction of gluten, %:			
	- raw	32,0	30,0	25,6
	- dry	12,5	11,0	9,9
2	Gluten quality:			
	- extensibility, cm	14,0	12,0	8,0
	- H^{IDK}_{def}., units. instrument	70	69	50
	- Warhead – H^{IDK}_{def}, score	59,6	54,0	60,0
	- hydration capacity, %	156	173	159
3	Mass fraction of protein, %:			
	- general	14,8	14,4	10,6
	- water-soluble	2,9	2,6	2,2
	- water-soluble, % to total protein	19,6	18,0	20,7
4	Protein utilization rate per gluten formation	0,84	0,76	0,93

It was found that in samples of laboratory-milled flour with a yield of 70%, the content and quality indicators of raw gluten are within the normalized limits. Comparative analysis of the data in Table 1 showed that the mass fraction of gluten in flour of the Yuna variety was 4.4% higher than that in the flour of the Kupava variety. The dry gluten content in the test flour samples was sufficient, the hydration capacity varied from 156 to 173%. In terms of extensibility and elasticity, gluten corresponded to quality group II. In terms of compression deformation, flour of the Kupava variety was characterized as “satisfactorily strong” (35 - 50 units of the IDK-1 device), of the Yuna variety - “good” (55 - 75 units of the IDK-1 device).

The Kupava wheat flour had the maximum value of the bonus number, which characterized it as “strong”. The state of the carbohydrate-amylase complex was judged by the content and properties of starch, sugars (general and reducing), sugar and gas-forming ability of flour. The analysis results are shown in Table 2.

Table 2

Characteristics of the carbohydrate-amylase complex of flour

№	Indicators	Control	Grain wheat flour	
			Yuna	Kupava
1	Mass fraction of starch, %	67,54	58,45	62,70
2	Mass fraction of sugars, %	2,44	2,27	2,36

	(in terms of glucose): - common - reducing	2,21	2,04	2,20
3	Mass fraction of pentosans, % including: - water insoluble - water soluble	3,30 2,70 0,60	3,20 2,50 0,70	3,60 2,60 1,00
4	Sugar-forming ability, mg maltose / 10 g flour	223	204	239
5	Flour gas generating ability, $см^3$ CO_2	1350	1312	1620

It was found that Kupava wheat flour had an increased sugar-forming ability. The amount of starch and sugars was higher than in Yuna wheat flour, by 3.35 and 0.09%, respectively. Reducing sugars in Kupava flour made up 2.2%, which is 0.16% higher than in Yuna flour, but corresponds to the value of the control variant. The gas-generating ability of Kupava wheat flour is significantly higher than that of Yuna flour and the reference sample. In terms of the content of pentosans and their individual fractions, Yuna and Kupava wheat flour is on average close to high-quality bakery flour, which should have a positive effect on its baking properties.

3. Discassion:

Amylographic studies (Table 3) showed that the starch of flour from Kupava grain differed from the starch of flour from Yuna grain by lower temperatures (by 2.5 ° C) and time (by 2.0 minutes) of starch gelatinization. This led to an increase in the rate of hydrolytic degradation of starch, as a result, a greater amount of monosaccharides, which are the main food of the yeast microflora, accumulated, which contributed to an increase in the rate of accumulation of yeast metabolic products, in particular carbon dioxide.

Determination and comparative analysis of the baking properties of flour of wheat varieties Yuna and Kupava made it possible to predict the quality of flour semi-finished products prepared on their basis. To confirm the earlier assumptions, we studied the rheological properties of the dough from the test flour samples, as well as the intensity of biochemical and microbiological processes in it.

Table 3
Amylogram indicators of flour

№	Properties of water-flour suspension, characterized by amylogram	Indicators of water-flour flour suspensions		
		Control	from wheat grain varieties	
			Yuna	Kupava
1	pH suspension at temperature, °C: 25 70	 6,04 5,54	 6,00 5,56	 5,57 5,40
2	Maximum viscosity, units arr.	340	340	325
3	Time before the start of gelatinization, min	20	23	21
4	Temperature of the beginning of gelatinization, °C	54	60	58

The dough was prepared in a safe way. The nature of the course of biochemical and microbiological processes in the dough and changes in its rheological properties during fermentation were judged by changes in the values of acidity, gas formation, gas-holding capacity and spreading of the dough ball (Table 4).

Table 4

Test quality indicators

№	Indicators	Flour dough		
		comparison sample	wheat grains	
			Yuna	Kupava
1	Acidity, hail: - initial - the ultimate	 2,20 3,50	 2,30 3,70	 2,30 4,00
2	pH	5,28	5,23	5,20
3	Lifting force, min.	10	12	8
4	Gas generating capacity, cm^3 CO_2/100 g	1350	1312	1620
5	Gas holding capacity, cm^3	40	38	36
6	Blurring of the dough ball at the end fermentation (in relation to H:D)	0,40	0,38	0,55

From the data table. 4 it follows that the values of titratable and active acidity varied within acceptable limits for the unpaired method of testing. The lifting force of the Kupava grain flour dough, which characterizes the rate of gas formation, was the highest, which is explained by its increased gas-forming ability.

4. Result:

It was assumed that the value of the indicator of the gas-holding capacity of the dough, which characterizes the increase in the volume of the dough piece during fermentation, should be higher for the Kupava grain flour, which has an increased gas-forming ability and strong gluten, compared to the dough from other flour samples. However, the value of this indicator in the Kupava wheat flour dough was the lowest. Obviously, this is due to the fact that with an insufficient amount of strong gluten, its threads provide sufficient resistance to the tensile force of carbon dioxide formed during fermentation, as a result of which the dough piece does not reach the expected volume during the fermentation period.

Samples of pan and hearth bread from laboratory baking tests were evaluated in terms of organoleptic and physicochemical parameters 16 hours after baking. The results of the analysis of the quality of bread are shown in table. five.

Table 5

The results of the analysis of the quality of bread of test laboratory baking from various flour samples

№	Quality indicators of bread	Flour bread		
		Sample comparisons	Wheat grains	
			Yuna	Kupava
1	Humidity, %	44,0	44,0	44,0
2	Acidity, hail	3,6	3,7	3,7
3	Specific volume of bread,sm^3/100 g	320	309	285

4	Porosity, %	76	75	74
5	Form stability (H:D)	0,46	0,40	0,55
6	Bread shape	Bread with a noticeably convex top crust		
7	Peel color	Dark golden		Intense brown
8	Surface condition crust	Smooth enough, small cracks and dents		Rough, not glossy enough
9	Crumb color	Light, uniform		
10	Porosity structure	The pores are small and thin-walled		Pores of various sizes, medium thickness
11	Structural and mechanical properties of crumb	Soft, elastic crumb		Compacted, elastic
12	Aroma (smell)	Pronounced, characteristic, bready		
13	Taste	Pronounced, characteristic, bready		
14	Crumb chewiness	Gentle enough, chews well		A little rough, slightly lumpy

From the data table. 5 it follows that the wheat flour of the control variant has good baking properties. The quality of the bread made from this flour without the use of additives received a high score (80.1 points). Products made from wheat flour Yuna were rated 78.0, Kupava - 73.8 points.

Thus, it was found that Yuna wheat flour has good baking properties. According to the totality of all indicators, the bread made from it meets the requirements for good quality products. When using flour from Kupava wheat in bakery production, in order to obtain good quality products, it is necessary to use additional technological methods (mixing with flour with a high gluten content of medium or weak strength, the use of a sponge method of dough making, the combined use of improvers of the reducing and oxidative action, etc. .).

The examination of the quality of flour was carried out by organoleptic, physicochemical and safety indicators [3].

The color depends on the type and grade of flour. Higher grades of flour are always lighter, and lower ones are darker, they contain shell particles.

The taste of flour should be characteristic, pleasant, mild, without crunch when chewing. Foreign tastes (bitter, sour) are not allowed.

The smell of flour is weak, specific. Moldy, musty and other foreign odors are not allowed.

The results of the study of organoleptic indicators of the quality of wheat flour are shown in table 6. The data in Table 6 show that all varieties of wheat flour have high organoleptic quality indicators.

Table 6

Organoleptic indicators of the quality of wheat flour

Indicators	Grain wheat flour	
	Yuna	Kupava
Colour	All flours are white, Yuna flour is slightly lighter than Kupava flour	
Smell	Weak, specific, without moldy, musty and other foreign odors	
Taste	Pleasant, typical of wheat flour, without crunch when chewing. No foreign tastes	

In the study of physical and chemical indicators of the quality of flour, the size of grinding, the content of metal-magnetic impurities, the amount and quality of raw gluten were determined.

The coarseness of grinding characterizes the degree of grain refinement and affects the technological properties of flour. Excessively coarse flour has a reduced water absorption capacity. The dough formation process slows down, and the bread is of poor quality. If the flour is crushed too much, the bread is insufficient in volume and quickly becomes stale.

The optimum size is to some extent related to the quality of the gluten and the size of the starch grains. Flour with strong gluten should be somewhat finer than with weak. From the point of view of processing properties, it is desirable that the flour has the most uniform particle size. In all studied varieties of wheat flour, the particle size ranged from 10 μm to 250 μm. It was found that Yuna flour contains 50-100 microns larger particles than Kupava flour.

The content of metal-magnetic impurities in all sorts of flour was, respectively, 2.1; 2.5 mg / kg.

The amount of wet gluten in the samples was 32; 30% respectively. The quality of gluten was assessed by color and smell, elasticity and extensibility. In the studied samples, the gluten is white with a grayish tinge, the smell is characteristic of wheat flour dough, the extensibility was 13; 11 cm respectively.

The quality of gluten was also established with the help of an IDK-1 gluten deformation meter, in which a force acts on a gluten ball weighing 4 g for 30 s. The deeper the punch of the device is immersed in the gluten, the worse it is in quality. These indicators in the samples were 68; 65 conv. units device.

Infection and contamination of flour by pests is not allowed. Contaminated flour cannot be sold.

When assessing the quality of flour according to safety indicators, the content of toxic substances, in particular metals and mycotoxins, was determined in their composition.

According to the decision of the Joint FAO / WHO Commission on the Food Code, eight chemical elements are included in the number of components controlled in international food trade - these are mercury (Hg), cadmium (Cd), lead (Pb), arsenic (As), copper (Cu), strontium (Sr), zinc (Zn), iron (Fe) [4].

Permissible levels of toxic elements in wheat flour are: lead 0.5; cadmium 0.1; arsenic 0.2; mercury 0.02; copper 10.0; zinc 50.0 mg / kg.

The results of a study on the content of toxic elements in wheat flour are shown in Table 7..

Table 7

Content of toxic elements in wheat flour

Wheat flour	Toxic elements, mg/kg					
	Pb	Cd	As	Hg	Cu	Zn
Yuna	0,35	0,05	0,18	0,02	7,8	45,0
Kupava	0,45	0,06	0,12	0,02	6,9	42,0

The content of toxic elements is much lower than the maximum permissible concentrations and does not pose a danger to the human body.

Mycotoxins are secondary metabolites of microscopic molds. From a hygienic point of view, these are especially dangerous toxic substances that contaminate food. Permissible levels of mycotoxins in wheat flour are: aflatoxins 0.005; Zearalenone 1.0; T-2 toxin 0.1; deoxynivalenol 0.5 mg / kg. [5-12]

The results of the study on the content of mycotoxins in wheat flour are shown in table. eight.

Table 8
Mycotoxin content in wheat flour

Grain wheat flour	Mycotoxins, mg / kg			
	Avlotoxin B_1	Zearalenon	T-2 toxin	Deoxyni-valenol
Yuna	0,005	0,9	0,1	0,5
Kupava	0,005	0,8	0,1	0,5

The results obtained in terms of physical and chemical indicators and safety indicators indicate that the qualities of all varieties of wheat flour meet the requirements of the standard and do not exceed the permissible levels.

5. Conclusion:

In addition to the above indicators, the quality of wheat flour is also assessed by their defects. The most common flour defects are: flour damaged by a bug, overheated grain flour, self-heating grain flour, frost grain flour. When making bread from defective flour, it is customary to carry out activities aimed at improving the quality of finished products.

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