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Research Article

Comparative Characteristics of Flour Milling Properties of Grinding Batches of Durum Wheat Grain of Industrial Mills

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Abstract

Research has been carried out to determine the potential milling properties of grinding lots of durum wheat grain of 4 operating large milling enterprises. The grinding of the initial samples was carried out according to a developed technological scheme with the inclusion of 6 torn, 2 sieve and 3 grinding systems, as well as a grinding system. According to the results of the research, it can be established that out of the four submitted samples of grinding parties of operating flour mills for processing grain of durum wheat, the sample from the Oryol region has the best flour-grinding properties, in which the total yield of flour for pasta was 83.8%, including ... 63.2% of the highest grade flour 20.6% of the second grade flour and 16.2% of bran. The modes of extraction of intermediate products of processing of grinding lots of durum wheat were: on the first torn system 19.5-26.2%, on the second torn system - 50.0-58.9% and on the third torn system - 40.3-52, eight%.

The largest yield of large-scale products and flour of the 2nd grade was obtained from the grinding batch of durum wheat grain of the flour mill located in the Oryol region, which amounted to 80.7%, and the smallest - from the flour mill located in the Moscow region, which amounted to 71.1%.

Keywords: durum wheat; a grinding party; flour for pasta; exit; Ash content

Introduction

Durum wheat is the most preferred raw material for the processing and production of flour for pasta. Currently, the State Register of Protected Breeding Achievements of the Russian Federation contains 46 varieties of spring durum wheat grain and 22 varieties of winter durum wheat grain.

Durum wheat grain differs from soft wheat grain in increased vitreousness, a higher protein content (from 14 to 17%) and gluten

(above 30%), is the only raw material for the manufacture of high-quality pasta, which are recommended for use as dietary foods in medical and prophylactic and children's institutions [2, 5-7, 11, 17, 19, 21].

Durum wheat is characterized by high vitreousness of grain (more than 90%), which determines its high technological properties [3, 8]. The yield of flour for pasta can reach up to 70% [13-16]. Wheat groats in its popularity in Russia ranks third, second only to buckwheat and rice, but it is more affordable and this is its advantage.

In addition to flour for pasta, high-quality cereals Poltava and Artek are produced from durum wheat grain. Porridges from them get the best taste, crumbly and do not boil, unlike cereals from soft wheat.

In addition, pasta made from processed products of durum wheat grains has a lower glycemic index (the rate of absorption by the body of carbohydrates contained in the food and an increase in blood sugar levels) [18, 20].

In their structure, starch grains of processed products of durum wheat grain are smaller and harder than from soft wheat grain. In this regard, durum wheat pasta dough has sufficient density, viscosity and resists rupture well, while absorbing a small amount of water (up to 35%). The dough is elastic, and at the same time, elastic and does not undergo adhesion during the drying process. These structural and mechanical qualities provide the technological process of pasta manufacturing and exclude the deformation of products during the production process [18, 21].

Pasta from processed products of durum wheat grain can be stored for a long time without losing taste and nutritional properties [6, 23]. It has been established that the strength of pasta made from winter durum wheat flour increases with long-term storage, and from soft wheat flour, on the contrary, decreases [22-25].

It should also be noted that the caloric content of pasta from processed products of durum wheat grain is much lower than from flour from soft wheat. They have a good balance of gliadin and glutenin, contain much more nutrients, vitamins of group B, PP, E [26-29]. The quantity and quality of gluten determine the advantages of pasta, affect the physical and rheological properties of the finished product obtained. In terms of nutritional value and easy digestibility, the protein of durum wheat grain approaches the protein of dairy origin, which makes it an indispensable raw material for the preparation of children's and dietary foods [18-21].

Russian scientists have developed new methods for evaluating grain material at the early stages of selecting experimental material for the creation of popular varieties for breeders. One of these express methods is the method of assessing the rheological properties of the dough from durum wheat flour (semolina) on the scale of assessments of the mixographic curve. It was found that the stronger and more elastic gluten, the more resistant to digestion pasta, and hence their nutritional and culinary properties. This is especially important for the production of thin spaghetti [4].

Studies have been carried out to identify the direct action and aftereffect of solid products of the biogas plant used as a fertilizer for crops on technogenically disturbed light gray forest heavy loamy soils in the link of the crop rotation "barley - spring wheat". The experiments used the products of a biogas plant obtained during anaerobic processing of bird droppings [11].

In crimea, studies have been conducted to determine the effect of nitrogen fertilizers and preparations "Flora-C" and "Phytop-Flora-S" on the yield and quality of winter durum wheat grain [12].

Kazakh scientists have established that the quality of Kazakhstan's spring durum wheat grain is quite suitable for use in pasta. It is revealed that the technological indicators of the quality of spring durum wheat grain comply with GOST 9353-2016, which means that durum wheat is in demand in the Kazakhstan and international markets [1].

Belarusian scientists conducted a study of 256 samples of spring durum wheat of various ecological and geographical origin in the conditions of the north-eastern part of the Republic of Belarus. The economically useful features are analyzed: the height of the plant, the elements of productivity and the main indicators of grain quality. The difference in samples by zones of origin is established, forms

that are promising for use in breeding for productivity and quality of grain are allocated [8, 18].

The purpose of the study is to determine the potential flour milling properties of milling batches of durum wheat grain of 4 operating large flour milling enterprises.

Objects and methods of research

As objects of research, grinding batches of durum wheat grain of flour milling enterprises located in the Moscow, Lipetsk, Orel and Orenburg regions were used.

Baseline grain quality indicators of milling batches of durum wheat grain, determined on the Infrared Grain Analyzer SpectraStar 2500 XL, are presented in Table 1.

Quality indicators of a milling lot of durum wheat	*Moscow region*	*Lipetsk region.*	*Orlovskaya region.*	*Orenburg-Region*
Natura, d/l	811	809	817	807
Humidity, %	11,9	12,1	12,0	11,6
Fat, %	1,17	1,23	1,19	1,28
Ash, %	1,98	1,91	1,89	1,85
Fiber, %	1,99	2,21	2,09	2,01
Protein, %	13,6	13,2	12,9	12,8
Amount of gluten, %	25,6	26,8	25,7	26,1
Gluten quality, unit. pr. IDK	88 II – удовл.	86 II – удовл.	91 II – удовл.	89 II – удовл.
Vitreous, %	89	91	94	92
Drop number, s	405	364	427	417

Table 1: Quality indicators of initial grinding batches of durum wheat grain.

The parameters and grinding modes for all samples of grinding batches of winter durum wheat on roller machines remained unchanged. Sieving of crushed winter durum wheat was carried out in a laboratory sieve with a set of 4 sieves with sizes of 900, 560, 315 and 220 μm. Enrichment of intermediate milling products of winter durum wheat was carried out on a laboratory sieve machine. The performance, set of sieves and airflow velocity of the sieve machine were selected separately for each fraction depending on the size of the enriched product. The parameters and modes of grinding corresponded to the recommended rules for the organization and conduct of the technological process at flour mills for pasta grinding of durum wheat.

The ash content of products of processing of durum wheat grain was determined according to GOST 27494-2016, humidity according to GOST 13586.5-2015. According to the data obtained, the samples of grinding batches of durum wheat grain used by us for research can be attributed to the 3rd class according to GOST 9353-2016 "Wheat. Specifications".

Results and their discussion

The study of the potential flour milling properties of milling batches of durum wheat grain was carried out according to a laboratory developed technological scheme, which includes 6 draught, 3 grinding, 3 sieve and 1 grinding system 14. Grinding was carried out on the grinding and sorting unit PCA-4. On all the pulling, grinding and grinding systems of the technological scheme for processing winter durum wheat grain, grooved rollers with a groove arrangement of the tip along the tip were used.

Sieving of intermediate products of grinding batches of durum wheat grain was carried out at laboratory sieving. Enrichment of intermediate milling products of winter durum wheat was carried out on a laboratory sieve machine. A set of sieves and the air flow

rate of the sieve machine were selected for each fraction depending on the size of the enriched product. The parameters and modes of grinding corresponded to the recommended rules for the organization and conduct of the technological process at flour mills for pasta grinding of durum wheat. The ash content of products of processing of durum wheat grain was determined according to GOST 27494-2016, humidity according to GOST 13586.5-2015.

Results of the study

At the first stage of research, laboratory grindings were carried out to determine the grain-forming ability of intermediate milling products of initial samples of milling batches of durum wheat grain. Laboratory grindings to determine the potential flour milling properties of the initial 4 samples of milling batches of durum wheat grain were carried out for each sample separately, with the production of four grinding products: pasta grits with a size of 315-560 μm, pasta groats with a size of 220-315 μm, flour of the second grade (pass 220 μm) and bran.

The modes of extraction of intermediate products of processing of grinding batches of durum wheat grain were: on the first draught system 19.5-26.2%, on the second draught system - 50.0-58.9% and on the third draught system - 40.3-52.8% (see Table 2-5).

The obtained experimental data on the yield of intermediate products of processing of grinding batches of durum wheat grain samples are presented in tables 2-5.

Technological system, value of intervalian clearance, mm	***Yield of intermediate products, %***				
	Gathering 900 μm	**Gathering 560 μm**	**Gathering 315 μm**	**Gathering 220 μm**	**Passage 220 μm**
I драная система, 0,80	80,5	9,2	6,1	1,5	2,7
II dranay system, 0,50	50,0	22,5	5,7	1,5	3,1
III dranaya system, 0,30	29,2	7,0	8,3	1,3	2,2
Altogether:		38,7	20,1	4,3	8,0

Table 2: Output of intermediate grinding products of a milling batch of durum wheat grain from the Moscow region.

As can be seen from Table 2, the total amount of cereal products and flour of the 2nd grade of processing of a sample of durum wheat grain of the flour milling plant located in the Moscow region at theI-III stripping cereal-forming systems amounted to 71.1%.

Technological system, value of intervalian clearance, mm	***Yield of intermediate products, % 53,7***				
	Gathering 900 μm	**Gathering 560 μm**	**Gathering 315 μm**	**Gathering 220 μm**	**Passage 220 μm**
I драная система, 0,80	78,1	10,4	6,4	1,6	3,5
II dranay system, 0,50	46,7	22,6	4,5	1,2	3,1
III dranaya system, 0,30	23,8	8,5	10,8	1,4	2,1
Altogether:		41,5	21,7	4,2	8,7

Table 3: Output of intermediate milling products of a milling batch of durum wheat grain from the Lipetsk region.

As can be seen from Table 3, the total amount of cereal products and flour of the 2nd grade of processing of a sample of durum wheat grain of the flour milling plant located in the Lipetsk region at theI-III dredged cereal-forming systems was 76.1%.

Technological system, value of intervalian clearance, mm	*Yield of intermediate products, %*				
	Gathering 900 µm	**Gathering 560 µm**	**Gathering 315 µm**	**Gathering 220 µm**	**Passage 220 µm**
I драная система, 0,80	75,4	12,3	6,1	2,2	4,0
II dranay system, 0,50	41,1	25,8	4,7	1,9	4,1
III dranaya system, 0,30	21,5	7,3	9,7	0,7	1,9
Altogether:		45,4	20,5	4,8	10,0

Table 4: Output of intermediate grinding products of a milling batch of durum wheat grain from the Oryol region.

As can be seen from Table 4, the total amount of cereal products and flour of the 2nd grade of processing of a sample of durum wheat grain of the flour milling plant located in the Oryol region at theI-III pancake-forming systems amounted to 80.7%.

Technological system, value of intervalian clearance, mm	**Yield of intermediate products, % 56,6**				
	Gathering 900 µm	**Gathering 560 µm**	**Gathering 315 µm**	**Gathering 220 µm**	**Passage 220 µm**
I драная система, 0,80	73,8	13,2	6,4	2,4	4,2
II dranay system, 0,50	43,4	19,1	4,5	1,2	2,8
III dranaya system, 0,30	23,8	7,3	9,4	1,2	1,9
Altogether:		39,6	20,3	4,8	8,9

Table 5: Output of intermediate milling products of a milling batch of durum wheat grain from the Orenburg region.

As can be seen from Table 5, the total amount of cereal products and flour of the 2nd grade of processing of the durum wheat grain sample of the flour milling plant located in the Orenburg region at theI-III stripping cereal-forming systems was 73.6%.

Thus, the largest yield of cereal products and flour of the 2nd grade was obtained from a grinding batch of durum wheat grain of the flour milling plant located in the Oryol region, which amounted to 80.7%, and the smallest - of the flour milling plant located in the Moscow region, which amounted to 71.1%.

At the second stage of research, laboratory grindings were carried out to determine the potential flour milling properties of the submitted samples of milling batches of durum wheat grain of various flour milling enterprises. The yield and quality of cereals, semi-rolls and flour of the 2nd grade, obtained from the initial grinding batches of existing flour mills for the processing of durum wheat grain, are presented in tables 6-9.

Grinding 1	*Yield, %*	*Humidity, %*	*Ash content %*
Krupka SV-1	46,1	16,0	0,75
Krupka SV-2	10,9	17,6	0,87
Flour 2 grade	21,8	16,6	1,92
Bran after the VI drain system	21,2	17,8	4,96

Table 6: Yield and ash content of processing products of a milling batch of durum wheat grain from the Moscow region.

As can be seen from Table 6, when processing milling batches of durum wheat grain from the Moscow region, the total yield of flour for pasta was 78.8%, including 57.0% of high-grade flour, 21.8% of second-grade flour and 21.2% of bran.

Grinding 1	*Yield, %*	*Humidity, %*	*Ash content %*
Krupka SV-1	53,0	16,5	0,82
Krupka SV-2	8,1	16,0	0,84
Flour 2 grade	20,4	16,0	2,41
Bran after the VI drain system	18,5	16,6	5,51

Table 7: Yield and ash content of processing products of a milling batch of durum wheat grain from the Lipetsk region.

As can be seen from Table 7, when processing a grinding batch of durum wheat grain from the Lipetsk region, the total yield of flour for pasta was 81.5%, including 61.1% of high-grade flour of 20.4% of second-grade flour and 18.5% of bran.

Grinding 1	*Yield, %*	*Humidity, %*	*Ash content %*
Krupka SV-1	52,2	16,4	0,73
Krupka SV-2	11,0	16,4	0,93
Flour 2 grade	20,6	16,4	1,61
Bran after the VI drain system	16,2	15,6	5,33

Table 8: Output and ash content of processing products of a milling batch of durum wheat grain from the Oryol region.

As can be seen from Table 7, when processing a grinding batch of durum wheat grain from the Oryol region, the total yield of flour for pasta was 83.8%, including 63.2% of high-grade flour, 20.6% of second-grade flour and 16.2% of bran.

Grinding 1	*Yield, %*	*Humidity, %*	*Ash content %*
Krupka SV-1	49,4	15,2	0,80
Krupka SV-2	9,9	15,2	0,96
Flour 2 grade	22,3	14,2	1,66
Bran after the VI drain system	18,4	14,8	5,69

Table 9: Yield and ash content of processed products of a milling batch of durum wheat grain from the Orenburg region.

As can be seen from Table 9, when processing a grinding batch of durum wheat grain from the Orenburg region, the total yield of flour for pasta was 81.6%, including 59.3% of high-grade flour, 22.3% of second-grade flour and 18.4% of bran.

Conclusion

Thus, according to the results of the studies, it can be concluded that from the four presented samples of milling batches of existing flour milling plants for the processing of durum wheat grain, a sample from the Oryol region has the best flour milling properties, in which the total yield of flour for pasta was 83.8%, including 63.2% of high-grade flour, 20.6% of second-grade flour and 16.2% of bran.

The modes of extraction of intermediate products of processing of milling batches of durum wheat grain were: on the first draught system 19.5-26.2%, on the second draught system - 50.0-58.9% and on the third draught system - 40.3-52.8%.

The largest yield of cereal products and flour of the 2nd grade was obtained from a grinding batch of durum wheat grain of the flour milling plant located in the Oryol region, which amounted to 80.7%, and the smallest - the flour milling plant located in the Moscow region, which amounted to 71.1%.

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