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Issue Article

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CHARACTERIZATION OF OLD LANDRACE WHEAT VARIETIES GROWN IN DIFFERENT ECOLOGICAL ZONES OF UZBEKISTAN IN TERMS OF GRAIN QUALITY AND RESERVE PROTEINS

Abstract: *Identification of old landrace wheat varieties of Uzbekistan by electrophoretic spectra of grain reserve protein -glyadin was carried out. It was revealed that samples collected from different places under the name Kizil Bugday have the same genotype, and varieties Ok Bugday and Grekum, belonging to the same variety, differ in electrophoretic spectra of gliadin. It was also revealed that Surkhak variety sown on large areas has two genotypes differing in electrophoretic spectra.*

Key words: *Landrace wheat varieties, electrophoretic analysis, gliadins, grain quality, gluten.*
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Introduction

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The diversity of cultivated and related wild plant species is the main fund for the development of state seed breeding and selection, it is an important component of ensuring food security of any country. All over the world, special attention is paid to the conservation of ancient local varieties, considering them as potentially useful sources of alleles of genes and polygenic systems that determine the resistance and tolerance of wheat to various unfavorable abiotic and biotic environmental factors [11].

Global climate change, negatively affecting crop yields, has caused food shortages in some regions of the world. Signs of it are observed in a number of African countries (Somalia, Kenya, Ethiopia). Population growth, the “demographic explosion”, intensifies this process. Ensuring food security has become a global problem of the XXI century, and it is waiting for its solution [1].

Agriculture is the main producer of food products. Currently, only 30 crops provide 95% of humanity's caloric food needs and only four of them - rice, wheat, maize and potatoes provide more than 60% [2,3]. Given that a relatively small number of crops play such a significant role in food security, it is essential that diversity within these major crops be maintained as a priority. Despite the small number of plants that provide energy and protein to the world's population, there is a very high diversity of plants [4,19,20]. Plant genetic diversity in the future will help to address the challenges of adapting to global climate change.

Global and regional population growth in Central Asia and the Caucasus requires increased wheat production in quantity and quality. Different climate change patterns are projected - rising temperatures during the growing season may cause drought [5,13,14,15]. In a number of countries wheat production is increasing due to the use of intensive irrigation technology. This leads to deterioration of the nutritional properties of bread. The increasing price of nitrogen fertilizers requires their efficient use by plants, which can be achieved by developing varieties responsive to this element.

Modern breeding is based on marker-associated selection. Evaluation of breeding material on the basis of protein markers makes it possible to carry out selection quickly and qualitatively enough and to control the transfer of desired traits from parental forms to hybrid populations. The most widely studied wheat proteins are the spare proteins gliadins and glutenins. The complete characterization of individual fractions and components of proteins is reflected in many scientific studies. Therefore, the study of genetic patterns of protein accumulation in the grain of different wheat varieties and the use in the identification of wheat genotypes as markers of gliadin protein components is the most urgent problem of our time [6,7,16,17,18].

Materials and methods.

Landrace local varieties of soft wheat collected from remote regions of Uzbekistan were taken as material for the study.

The method of one-dimensional electrophoresis in polyacrylamide gel in acidic aluminum-lactate buffer, pH 3.1, was used to study the spare proteins of the endosperm of grains (gliadins) [8]. Gliadin was extracted with 70% ethanol from the flour of individual grains. From 25 to 100 grains from each variety were analyzed, depending on the amount of material and the intra-varietal heterogeneity detected. A reference spectrum with 30 components divided into α-, β-, γ-, and ω-zones was used for protein formulae. The content of crude gluten and IDK indicators were determined according to GOST 135861 [9].

Research results.

During regular expeditions to the mountainous and foothill regions of Uzbekistan, numerous samples of landrace wheat varieties were collected and with the help of JPS-navigation device, the main places of cultivation, sowing area and prevalence of this ancient variety among the local population were determined. As a result of these studies and numerous surveys of the local population, a catalog and map of the distribution of ancient varieties in Uzbekistan was compiled [10].

Morphological analysis of these accessions in ears and grains showed that many of these accessions belong to the varieties Graecum with white ear and white grain, and Erithrospermum with white ear and red grain, although among them there are red-spiked forms belonging to the Ferrugineum species, as well as compact forms belonging to the T. compactum L. species.

These ancient wheat varieties adapted to rainfed conditions in Uzbekistan are characterized by high stem height, long ears, large grains and high baking qualities.

Table-1. Gluten content and IDK indices in landrace varieties of Uzbekistan.

№	Varieties	Variety collection locations	Gluten (%)	IDK	Quality
1	Kizil bugday	Kashkadarya (Kamashi, Kuga)	48,0	56,9	Good
2	Kizil bugday	Surkhandarya (Boysun, Kurgancha)	46,0	75,0	Good
3	Kizil bugday	Surkhandarya (Boisun, Gumatak)	44,0	56,0	Good
4	Kizil bugday	Surkhandarya (Boisun, Duoba)	38,0	61.0	Good
5	Kizil bugday	Surkhandarya (Boisun, Duoba)	42,8	52.8	Good
6	Kizil bugday	Kashkadarya (Kamashi, Kuga)	45,0	68.7	Good
7	Ok bugday	Kashkadarya (Kamashi, Kuga)	50,0	83.5	Satisfactorily weak
8	Ok bugday	Kashkadarya (Kamashi, Kukbulak)	48,6	80.0	Satisfactorily weak
9	Grekkum	Jizzakh (Bahmal, Dangara)	46,0	63.2	Good
10	Unnamed.	Кашкадарья (Яккабог, Теракли)	50,0	65.9	Good
11	Unnamed.	Kashkadarya (Kamashi, Tegirmonqul)	48,0	80.0	Satisfactorily weak
12	Unnamed.	Kashkadarya (Kamashi, Kiziltom)	56,0	74.8	Good
13	Unnamed.	Kashkadarya (Kamashi, Kuga)	45,6	44.0	Good
14	Boboki	Surkhandarya (Boisun, Duoba)	38,8	73.8	Good
15	Kalbugday	Kashkadarya (Kamashi, Kiziltom)	33,6	45.0	Good
16	Buhorbobo	Kashkadarya (Kamashi, Kiziltom)	42	68,8	Good
17	Surhak	Jizzakh (Bahmal, Udamali)	26,4	117.0	Satisfactorily weak
18	Surhak	Kashkadarya (Yakkabog, Terakli)	34,0	80.0	Satisfactorily weak

Under rainfed conditions in optimal years, the average yield is 2.5 t/ha, and in some areas it reaches up to 3 t/ha. In dry years, yields drop. Under irrigated conditions, growth and lodging increases in these varieties. One of the important aspects of these varieties is that they retain high quality and under irrigation conditions, it allows to use them as a donor in the creation of new varieties with good baking qualities.

Analysis of crude gluten content and IDK values showed that gluten content was high in all samples of old varieties, compared with the control variety Surkhak, as well as with all commercial varieties cultivated in the country.

In terms of gluten quality, all samples of Kizil Bugday variety and one sample from Terakli Kashkadarya of Ok Bugday variety had good quality. The other two samples of Ok Bugday variety and one sample of Surkhak variety, although had high gluten content, but their quality was rated satisfactorily weak, one sample of control variety Surkhak had low gluten content - 26%-, and the quality was rated unsatisfactorily weak (Table 1). Among the samples collected, there were unnamed varieties which also had good baking qualities. The local population, who had grown these varieties for many years, selecting every year, good ears for reseeding, kept these varieties in almost homogeneous condition, as shown by electrophoretic analysis of the spare grain proteins.

As is known, the electrophoretic spectrum of spare grain proteins gliadins and glutenins is genetically determined and does not depend on growing conditions. Gliadins, being in the form of monomeric chain, constitute 50% of grain proteins and in terms of electrophoretic mobility and consist of 4 different forms (α-gliadin, β-gliadin, γ-gliadin, ω-gliadin) [11,12].

To identify our collected samples of ancient varieties, 100 ears from each sample were selected by electrophoretic analysis and a grain from each ear was analyzed. Electrophoretic analysis of unnamed varieties showed that these samples are representatives of two homogeneous varieties, and they clearly differ in electrophoretic spectra (Fig. 1). Comparison of the electrophoretic spectrum with the spectra of other collected varieties (Fig. 2). showed that they represent distinct varieties developed by folk breeding over many years.

Among the collected specimens, many specimens are found under the name of Kizil Bugday and Ok Bugday. These varieties differ in the color of the grain and therefore the local population defines them by this feature. Interestingly, all the varieties named Kizil Bugday collected from different regions were mostly cultivated at an altitude of more than 1500 above sea level and all these samples had the same electrophoretic spectrum.

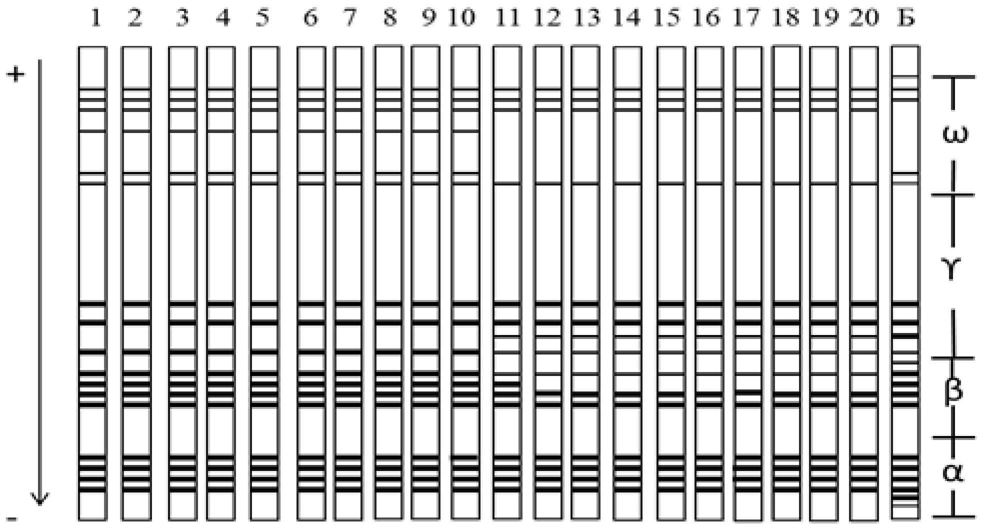

Figure 1. Electrophoregrams of two old-aged varieties without name. 1-10 the first variety without name and 11-20 the second variety, B-unnamed-1.

A sample called Boboki, high-yielding, with large grain, strong stem, morphologically similar to the variety Kizil Bugday was also collected from this region, although electrophoretic analysis shows that these varieties belong to different genotypes (Fig. 2, dor.3).

Another variety called Ok bugday, with white spikelet and white grain, according to morphological identification belonging to Graecum varieties, was called as Ok bugday in the regions of Kashkadarya oblast, and as Grekum in Jizzakh region. The electrophoretic spectra of all samples of Ok Bugday variety collected in Kashkadarya were identical (Fig.2, dor 4), but they clearly differed in electrophoretic spectra from the Graecum variety collected from Jizzakh region (Fig.2, dor 5). This shows that these two varieties, although belonging to the same variety, are genotypically different varieties.

Commercial variety Surkhak, included in the list of ancient varieties, was released in 50 years of the last century, and for more than 70 years has been cultivated in Uzbekistan and occupies the main areas of rainfed zones. Electrophoretic and morphological analysis of different samples of this variety revealed numerous admixtures of other varieties. Since these impurities were found mainly in single ears and in small quantities, we rejected them and identified two Surkhak varieties from two regions, which differed in electrophoretic spectra of gliadin (Fig. 2, dor. 9-10).

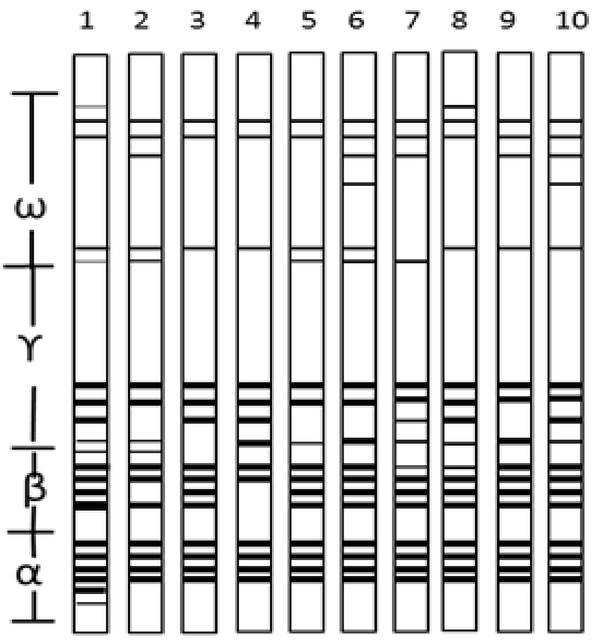

Fig.2. Electrophoregrams of old varieties: 1.Bezostaya-1, 2- Kizil Bugday, 3-Boboki, 4- Ok Bugday, 5-Greacum, 6- Untitled (Terakli), 7- Untitled (Kiziltom), 8- Bukhorbobo, 9- Surkhak (Bakhmal) and 10-Surkhak (Udamali).

Thus, identification of old local varieties of Uzbekistan by electrophoretic spectra of gliadin showed that all samples named Kizil Bugday with white spikelet and red grain, belonging to the variety Erithrospermum, originated from one variety and preserved in homogeneous condition. Samples of Ok Bugday and Graecum belonging to the same species Graecum appeared to be different varieties of the same variety. Samples of varieties without name, belonging to Erithrospermum species, differed in ef. spectra both among themselves and from Kizil Bugday, which indicates that they originated from different genotypes.

Surkhak variety, which is sown on a large area, belongs to two different genotypes. Additional research is required to clarify their origin and relationship.

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