COMPARATIVE EVALUATION OF THE PHYSICAL AND CHEMICAL PROPERTIES OF LOCAL TRITICALE GRAIN WITH OTHER CEREAL VARIETIES

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СРАВНИТЕЛЬНАЯ ОЦЕНКА ФИЗИКО-ХИМИЧЕСКИХ СВОЙСТВ ЗЕРНА МЕСТНОГО ТРИТИКАЛЕ С ДРУГИМИ СОРТАМИ ЗЛАКОВЫХ КУЛЬТУР

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ABSTRACT

The study presents a comparative analysis of the physicochemical parameters of local triticale grains ("Sardor") in relation to wheat ("Sila") and rye ("Vakhsh-116") grains. The research was carried out according to GOST standards (13586.5-85, 10840-64, 10842-89, 10987-76, 10847-74, 23586.1-68). Results showed that the vitreousness of rye and triticale grains was 25–27% higher than that of wheat grains. However, the findings indicate limited suitability of rye and triticale for baking flour production. Therefore, further studies of their chemical composition and technological properties are recommended to assess their potential in flour milling and food processing.

АННОТАЦИЯ

В работе представлен сравнительный анализ физико-химических показателей зерна местного тритикале сорта «Сардор» по отношению к зерну пшеницы («Сила») и ржи («Вахш-116»). Исследования проводились в соответствии с ГОСТами (13586.5-85, 10840-64, 10842-89, 10987-76, 10847-74, 23586.1-68). Результаты показали, что стекловидность зерна ржи и тритикале на 25–27% выше, чем у зерна пшеницы. Однако полученные данные свидетельствуют об ограниченной пригодности ржи и тритикале для производства хлебопекарной муки. Поэтому рекомендуется дальнейшее изучение их химического состава и технологических свойств для оценки потенциала их использования в мукомольном и пищевом производстве.

Keywords: wheat, rye, physicochemical parameters, vitreousness, flour production.
Ключевые слова: пшеница, рожь, физико-химические показатели, стекловидность, производство муки.

Introduction. At present, cereal crops and cereal products occupy an important place in the human diet worldwide. Optimizing the energy and essential amino acids highlight their nutritional significance. Traditional cereals such as wheat, rye, barley, and maize have developed over thousands of years through evolutionary selection, while triticale is a relatively recent cultivated crop created by crossing wheat and rye. It is currently cultivated in 18 European countries, with about half produced in Poland, and the remainder in France, Germany, Hungary, Austria, the Baltic states, the Czech Republic, Denmark, Sweden, and partly in Italy and the United Kingdom.

Material and methods. In this study, local triticale grain samples were collected from various agricultural regions and compared with samples of wheat, barley, and oats. The physical properties, including grain size,

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weight, and moisture content, were measured using standard laboratory techniques, while chemical properties such as protein content, fiber, and mineral composition were analyzed using spectroscopic methods and chromatography.

Discussions and results. Today, triticale is mainly grown as a raw material for the feed industry, but breeders are actively developing new varieties intended for food processing. In Uzbekistan, research on local varieties is being conducted at the "Research Institute of Grain and Leguminous Crops, Gallaaral Experimental Station."

Triticale is used in the production of alcohol, beer, and kvass, as well as for baking bread and confectionery products. Although domestic milling enterprises are currently focused on processing wheat, the development of new technologies and the introduction of triticale as an additional raw material are considered promising directions [1].

Bread made from triticale flour is characterized by its higher nutritional value due to increased protein content and essential amino acids, particularly lysine. The physicochemical parameters of grain—such as size, shape, volume, vitreousness, kernel weight, grain nature, and 1000-kernel weight—play a decisive role in flour yield and quality. Therefore, expanding flour assortments, processing bioactive compound-rich cereals, and producing protein-enriched products remain urgent tasks for the country's food industry [2].

Research Objective

The main objective of this research is to conduct a comparative study of the physicochemical parameters of local triticale grain with those of local wheat and rye varieties, and to evaluate its technological potential for flour production. To achieve this goal, the physicochemical characteristics of wheat, rye, and triticale grains cultivated in Uzbekistan were analyzed. For the study, wheat grain variety "Sila," rye grain variety "Vakhsh-116," and triticale grain variety "Sardor" were selected, and their physicochemical properties were determined using standard analytical methods.

Research Methods

To perform the technological analysis of the studied wheat grains, standard methods were applied. The analyzed samples were tested according to the following standards:

Moisture content — determined according to GOST 13586.5-85 using a CESH-3M (Russia) drying oven at 130 °C for 40 minutes;

Grain nature (bulk density) — determined according to GOST 10840-64 using a PX-1M (Russia) laboratory device;

Thousand kernel weight — determined according to GOST 10842-89;

Vitreousness — determined according to GOST 10987-76 using a "Yantar" (Russia) diafanoscope;

Ash content — determined according to GOST 10847-74 by incineration in a muffle furnace at 600–900 °C;

Gluten quantity and quality — determined according to GOST 23586.1-68;

Metal-magnetic impurities — determined according to GOST 20239-74.

Results and Discussion

A comparative analysis of the physicochemical parameters of wheat grain variety "Sila," rye grain variety "Vakhsh-116," and triticale grain variety "Sardor," cultivated in Uzbekistan, was carried out. The selected grain samples were first cleaned and sieved using a 1.7×20 mm mesh. The fine fractions were separated, and the physicochemical parameters of the coarse fractions were determined. The experimental results are presented in Table 1.

Table 1.

Physicochemical characteristics of wheat, rye, and triticale grain varieties

Indicators	Sila (Wheat)	Vakhsh-116 (Rye)	Sardor (Triticale)
Moisture, %	9.0	11.9	10.0
Vitreousness, %	45	70	72
Test weight (g/L)	760	720	711
1000-kernel weight, g	37	27	28
Ash content, %	1.74	1.63	1.98
Gluten content, %	27	–	–
Gluten deformation index (IDK)	86	–	–
Grain volume, mm³	25.09	20.96	16.35
Grain surface area, mm²	58.60	65.10	51.98

The results presented in the table show that the moisture content of all grain samples corresponds to standard requirements [3]. However, the vitreousness of rye and triticale samples was 25–27% higher compared to wheat. Vitreousness is considered one of the main physical parameters for producing baking flour, as it significantly influences both yield and quality, as stated in some sources [4]. According to these standards, only soft wheat grains with more than 50% vitreousness are recommended for producing baking-grade flour. Therefore, the "Sila" wheat variety is not suitable for this purpose.

In terms of test weight, 1000-kernel weight, grain volume, and surface area, all samples corresponded

to standard values. At the same time, the lower ash content of rye compared to wheat indicates a lighter flour color and a higher proportion of endosperm, whereas the opposite tendency was observed for triticale [5].

Furthermore, when considering the functional properties of baking flour, gluten quantity and elasticity play a decisive role. The results demonstrated that wheat grain samples showed superiority in terms of gluten characteristics.

Conclusion. The experimental results showed that rye and triticale grains demonstrated positive indicators in terms of vitreousness, ash content, and test weight. However, their gluten content and elasticity were insufficient for producing high-grade baking flour. Therefore, a comparative study of their chemical composition is required.

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