THE INVESTIGATION FOCUSES ON HOW DIFFERENT RATIOS OF TRITICALE AND WHEAT FLOURS INFLUENCE THE RHEOLOGICAL CHARACTERISTICS OF DOUGH.

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Abstract: *This article discusses modern trends in the development of flour baking technology and methods for utilizing triticale grain. The rheological properties of dough prepared with various ratios of triticale and wheat flours, including water absorption capacity, gluten content, and starch retrogradation, were studied. Experimental results show that a 70:30 ratio of triticale to wheat flour yields optimal results. Additionally, further research is recommended on the high protein and amino acid content of triticale flour.*

Keywords: *Triticale flour, Wheat flour, Bread preparation, Rheological properties, Biotechnology, Starch retrogradation, Gluten content, Water absorption, Nutritional value, Dough quality, Flour baking technology, Optimal ratio, Functional bread, Dietary bread.*

The relevant trends in the development of flour baking technology are realized through the improvement of traditional methods, the production of products with high biological and nutritional value, and the use of biotechnological methods in advanced processing technology.

Experimental results from baking tests using triticale flour show that, despite its good gas-producing ability, triticale flour results in loaves with a lower volume compared to those made with wheat flour. The crumb is dense and adheres well to itself. Aside from TS-1, all studied triticale amphiploids can be applied in the baking industry. Additionally, it is recommended to conduct scientific research on the development of methods for producing functional flour and bread from triticale grain, which has therapeutic, preventive, and dietary significance.

The bread made according to the developed technology has the following indicators:

Comparative volume: 2.43 and 2.36 cm^3/g;

Porosity: 58% and 56%;

Acidity: 3.0 and 3.6 degrees;

Total compressibility of the crumb: 55 and 53.5 penetrometer units;

The content of lysine and tryptophan is 2% higher compared to bread made from traditional wheat flour.

When studying the freshness index of bread made from flours of similar yield from triticale and wheat, it was found that bread made from triticale flour has a longer shelf life. The aging process of bread products made from wheat flour was found to depend on the gluten content and its conditional unit indicators.

The rheological properties of triticale flour were studied in comparison with wheat and traditional flours, as well as their mixtures in various percentages using a microlab system. According to the experimental results, satisfactory rheological properties were observed in samples made from high-grade wheat flour with an addition of 20-50% triticale flour.

To enhance the baking properties of triticale flour, the effect of adding gluten derived from the deep processing of wheat grain on the baking and rheological properties was studied. The influence of 1%, 2%, 3%, 4%, and 5% wheat gluten on triticale flour was experimentally investigated. It was found that the falling number decreases, the gluten content increases, and the retrogradation process slows down.

Based on the above analyses, it is relevant to experimentally analyze the effects of different compositional mixtures of flour from locally sourced triticale grain and wheat on the rheological properties of the dough.

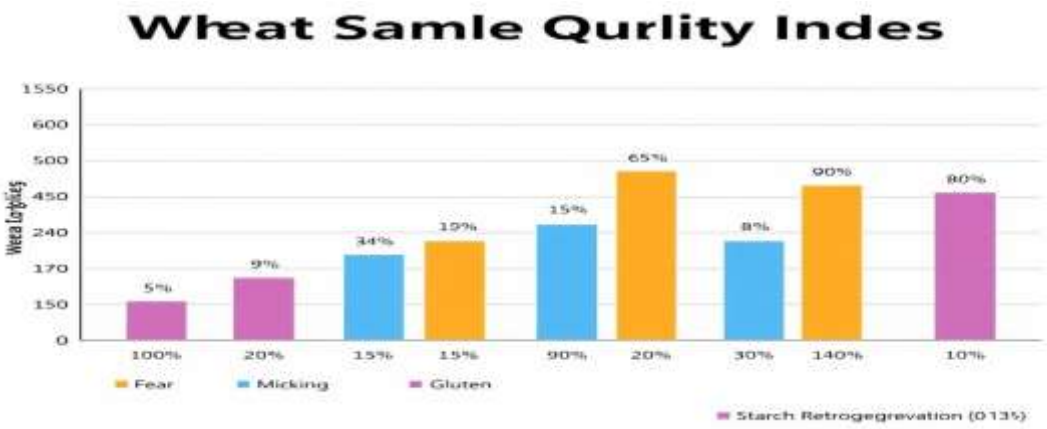
Its water absorption capacity is considered an important economic indicator that affects the volumetric yield of the dough. This indicator was determined using the Mixolab 2 (Chopin technology, France) equipment according to the NF ISO 5725 standard (ISO 27971:2015) [12-13].

The identification of rheological properties was conducted based on the "Chopin+" protocol, which includes five temperature intervals, using the Mixolab device from CHOPIN (France). The rotational moment measured at the points of interest on the graph describes various biochemical processes.

Results and Discussion: The objective comprehensive assessment of the quality of various grains and the flours derived from them is also based on their rheological properties. Therefore, this part of the research involved a comparative evaluation of the rheological properties of local “Sardor” and “Sila” varieties of triticale and wheat flour samples, as well as their various compositional blends, against a sample of flour derived from “Dauren” (Kazakhstan) triticale using the “Chopin+” mixolab equipment.

During the conducted research, the following indicators of dough rheological properties were recorded for all tested samples.

Profile indices of the mixolab.



The experimental results indicate that the "Water Absorption Index" (WAI) for flour derived from triticale grains is notably high. This is attributed to the abundance of peripheral parts of the grain. The "Gluten Index" reflects the stability of the protein structure of the dough at temperatures between 30-60 °C. The interpretation of the "Gluten Index" presents some complexity, as the heating of the dough from 30 °C to 60 °C involves two significant events. The "Gluten Index" for the wheat flour sample is equal to 2; according to the IDC device indicators, it falls into Group II, indicating satisfactory softness (first grade, 80 IDC units). Additionally, the "Gluten Index" for the sample of flour derived from triticale is equal to 4; the IDC device reading is 95 units.

The highest "Viscosity Index" was recorded for the “Dauren” (Kazakhstan) triticale flour, with a value of 5, while the local triticale flour sample showed a value of 4, and other samples had values up to 2.5 times lower. It is important to note that when considering other indices, particularly the "Amylase Index" and "Viscous Index," the viscosity is dependent not only on amylase activity but also on the state of starch, its quality characteristics, and the presence of non-starch polysaccharides in the peripheral parts.

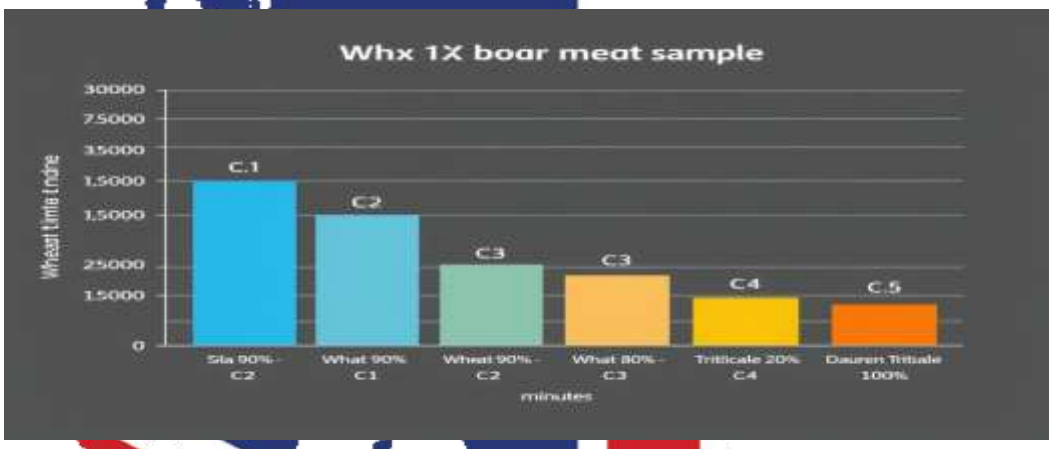
The "Starch Retrogradation Index" was found to be slightly higher in the sample of “Dauren” (Kazakhstan) triticale, which is linked to the amount of mechanically damaged starch and other structural properties as shown in Table 1.

Analysis of the obtained results and comparison with mixolab indices demonstrated that the activity of neutral proteases correlates with the "Viscous Index" relative to the "Gluten Index." It is noteworthy that no clear correlation was identified between the "Viscosity Index" (which describes the phase where physicochemical and biochemical parameters interact) and amylase activity. This may be due to the structural characteristics of starch in various types and varieties

of flour and the presence of non-starch polysaccharides.

The mixolab profile indices for the compositional blends of local “Sardor” triticale and wheat flour in a 70:30 ratio showed higher values compared to other samples. The compatibility of other experimental results obtained during the study with the rheological properties was also investigated. Accordingly, the rheological properties of the dough samples (Mixolab Chopin+) are detailed in

Main Parameters of Rheological Properties of Flour Samples (According to Chopin+)



The research results showed that the mixing time decreases with the increasing proportion of triticale flour in the blend. Specifically, when 10% triticale flour is added, the 'Mixing Index' decreases, and with 40% addition, the 'Water Absorption Capacity Index' is also reduced. Meanwhile, the 'Amylase Index' and 'Starch Retrogradation Index' remain unchanged. This is associated with the low amylolytic activity of the endosperm flour obtained from the central part of triticale grain. Even when 60% of triticale flour is added to wheat flour, it does not affect the overall amylolytic activity of the blend or the retrogradation capacity of the starch. The experimental results indicated that adding up to 30% of the first-generation triticale flour to first-generation wheat flour has almost no impact on the rheological properties of the dough.

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