TECHNOLOGIES FOR OBTAINING HIGH-NUTRITIONAL-VALUE PROTEIN PRODUCTS FROM WHEAT FLOUR PROCESSING

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Abstract: This article analyzes technologies for obtaining high-nutritional-value food products, specifically protein concentrates and gluten, from wheat flour processing by-products. It demonstrates that during the processing of wheat raw materials, valuable protein products can be produced alongside starch. The article describes technologies for separating wheat flour suspension into gluten and starch fractions, enzymatic hydrolysis, and obtaining protein concentrates. In addition, the biological value and amino acid composition of wheat proteins are analyzed, along with their application in bakery, pasta, sausage, confectionery products, as well as dietary and functional foods. The article also considers the potential of wheat raw materials and processing enterprises in the context of Uzbekistan. The implementation of these technologies has both economic and ecological significance and expands the possibilities for producing high-quality flour and additional valuable products in the national food industry.

Keywords: *wheat, protein concentrates, gluten, starch, amino acid composition, biological value, dietary products, functional foods, wheat flour processing technology, Uzbekistan.*

Аннотация: В статье проанализированы технологии получения высокоценной пищевой продукции, белковых концентратов и глютена из отходов переработки пшеничной муки. Показано, что в процессе переработки пшеничного сырья наряду с крахмалом могут производиться ценные белковые продукты. В статье рассмотрены технологии разделения суспензии пшеничной муки на фракции глютена и крахмала, ферментативного гидролиза и получения белковых концентратов. Кроме того, проанализированы биологическая ценность и аминокислотный состав пшеничных

белков, а также их применение в хлебобулочных, макаронных, колбасных, кондитерских изделиях, а также в диетических и функциональных продуктах питания. Рассмотрены возможности сырья пшеницы и предприятий по его переработке в условиях Узбекистана. Внедрение этих технологий имеет экономическое и экологическое значение и расширяет возможности производства качественной муки и дополнительных ценных продуктов в национальной пищевой промышленности.

Ключевые слова: *пшеница, белковые концентраты, глютен, крахмал, аминокислотный состав, биологическая ценность, диетические продукты, функциональные продукты питания, технология переработки пшеничной муки, Узбекистан.*

Annotatsiya

Ushbu maqola bug'doy unini qayta ishlashdan olingan mahsulotlar, xususan, protein konsentratlari va glutenlarni ishlab chiqarish texnologiyalarini tahlil qiladi. Uning ko'rsatishicha, bug'doy xom ashyolarini qayta ishlash jarayonida, kraxmal bilan birga qimmatbaho protein mahsulotlari ishlab chiqarish mumkin. Maqolada bug'doy unining suspenziyasini gluten va kraxmal fraksiyalariga ajratish texnologiyalari, fermentativ gidroliz va protein konsentratlarini olish jarayonlari tavsiflanadi. Shuningdek, bug'doy proteinlarining biologik qiymati va aminokislota tarkibi tahlil qilinadi, ularning non mahsulotlari, makaron, kolbasa, shirinliklar, shuningdek, parhez va funksional ovqatlarda qo'llanishi ko'rib chiqiladi. Maqola O'zbekiston kontekstida bug'doy xom ashyolari va qayta ishlash korxonalarining potentsialini ham o'z ichiga oladi. Ushbu texnologiyalarni joriy etish iqtisodiy va ekologik ahamiyatga ega bo'lib, milliy oziq-ovqat sanoatida yuqori sifatli un va qo'shimcha qimmatbaho mahsulotlarni ishlab chiqarish imkoniyatlarini kengaytiradi.

Kalit so'zlar

bug'doy, protein konsentratlari, gluten, kraxmal, aminokislota tarkibi, biologik qiymat, parhez mahsulotlari, funksional ovqatlar, bug'doy unini qayta ishlash texnologiyasi, O'zbekiston.

INTRODUCTION.During wheat flour processing, especially when using technologies without chemical reagents, it is possible to produce valuable protein products alongside starch. For example, gluten and protein concentrates are the most important products in this

process. Gluten is primarily used to produce high-quality flour for strong and medium-strength bread, while protein concentrates are mainly derived from low-gluten flour. [5,6].

Abroad, several technologies have been developed in countries such as Germany and the USA. These include converting wheat flour into a suspension, separating gluten, fractionating starch, and performing enzymatic hydrolysis using amylases. For instance, the German technology involves preparing the dough by crushing, washing it with water to separate gluten, filtering the starch suspension, and dividing the starch into first and second grades. In the USA, technologies are applied that separate flour suspension into starch and protein concentrates containing 25–40% protein, where the use of enzymes and optimal temperature and pH conditions are crucial. [3,5,6].

LITERATURE REVIEW.In Uzbekistan, wheat raw materials are abundant, and processing enterprises are operational. Improving agricultural product processing and obtaining valuable food products from by-products has significant economic and ecological importance for the country. Accordingly, implementing such technologies requires compliance with the Law of the Republic of Uzbekistan “On the Development of the Food Industry,” industrial waste and environmental protection regulations, as well as sanitary-hygiene and food safety standards. In this way, protein products and gluten obtained from wheat flour processing can expand the possibilities for producing high-quality flour and additional valuable products in the national food industry. [1,2,5,6].

The process of obtaining protein products from wheat flour processing

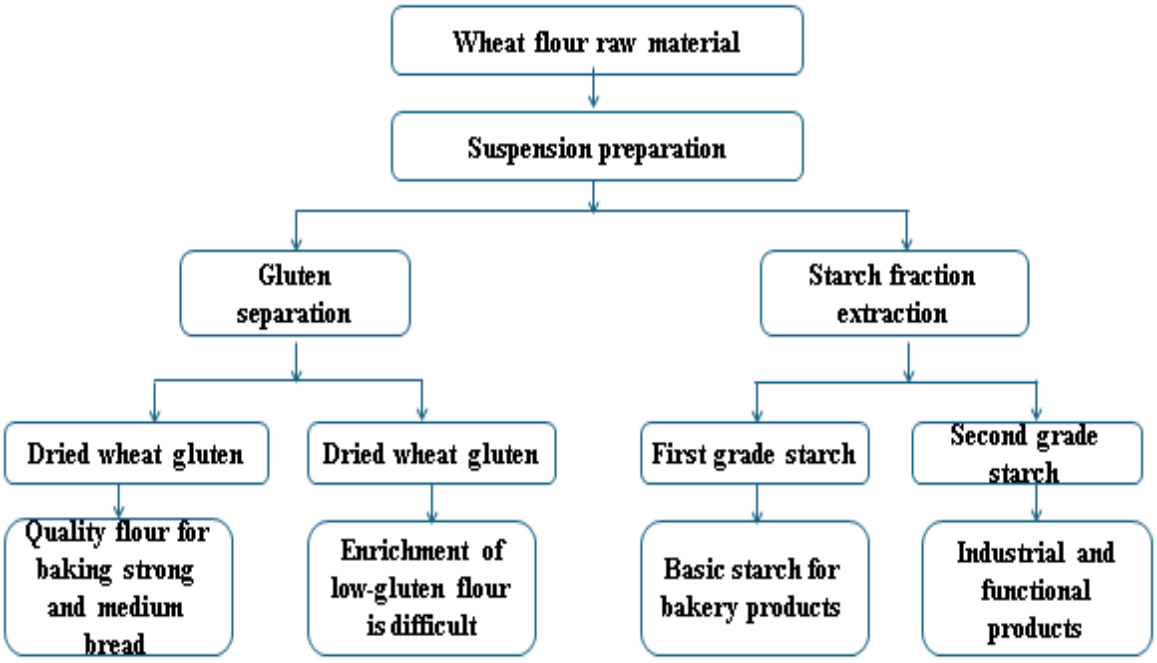

Figure 1. Technology for obtaining a protein product from wheat flour processing

The diagram shows the main protein products obtained from wheat flour processing, including dry wheat gluten, protein concentrates, and starch fractions. The primary applications of each product are indicated: dry wheat gluten is used to produce high-quality flour for strong and medium-strength bread; protein concentrates are used to enrich low-gluten flour and in dietary products. Starch fractions serve as the main raw material for bakery and industrial products. [5,6,8].

RESEARCH METHODOLOGY. The diagram shows the main protein products obtained from wheat flour processing, including dry wheat gluten, protein concentrates, and starch fractions. The main application areas of each product are indicated: dry wheat gluten is used to produce high-quality flour for strong and medium-strength bread; protein concentrates are used to enrich low-gluten flour and in dietary products. Starch fractions are considered the main raw material for bakery and industrial products. [3,5].

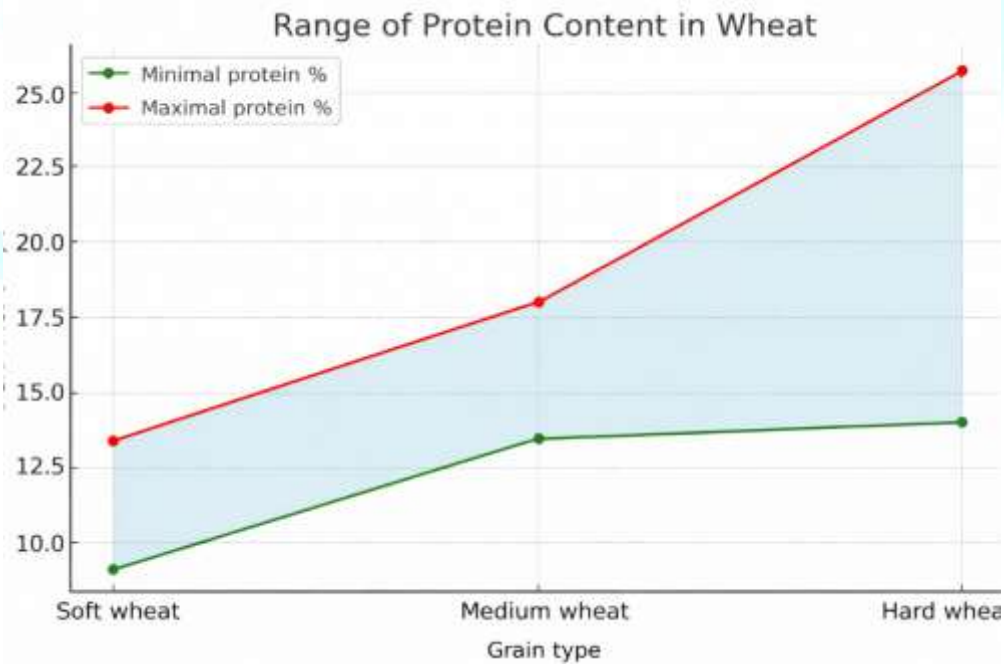

Figure 2. Protein content of wheat grain

DISCUSSION AND RESULTS. Proteins are the main biological substances of living cells, forming the basis of cell protoplasm, maintaining the structure of membranes and

organelles, performing transport functions, and supporting immunity. Additionally, the proteins in wheat grains determine the technological value of the raw material, particularly for baking and pasta products. The most important proteins in wheat grains are prolamins and glutelins, which constitute approximately 74% of the total protein mass. Prolamins (gliadins) and glutelins (glutenins) play a key role in forming gluten. In addition, albumins make up 20–22%, and globulins 5–6%. The highest protein concentration is found in the aleurone layer, while the endosperm contains a lower amount. [3,6,7,8].

Table 1

Protein Content in Morphological Parts of Wheat (Conditions in Uzbekistan)

Grain Parts	Varieties in the Sirdaryo Region (%)
Total Grain	13,5
Endosperm	10,5
Aleurone Layer	40–45
Germ	30–35
Seed Coat / Testa	15–20
Pericarp	2–3
Bran / Covering	7–10

The protein concentration is highest in the aleurone layer and lowest in the central part of the endosperm. When evaluating the nutritional value of wheat grains, the amino acid composition is of great importance. The germ contains the highest amount of essential amino acids, particularly lysine, which is more than twice the amount found in the endosperm. [5,6].

Table 2

Content of Essential Amino Acids in Wheat Proteins (Varieties in the Sirdaryo Region, % of Dry Matter)

Name	Lysine	Methionine	Tryptophan	Valine	Isoleucine	Threonine	Phenylalanine	Crude Protein (%)
Wheat	2,6	1,7	1,3	4,6	3,4	2,6	4,3	13,5

During hydrolysis, proteins produce a mixture of α-amino acids, which is important for increasing the biological value of protein concentrates. The amphoteric nature of amino acids allows them to form different salts in various environments. To date, more than 150 amino acids have been identified in nature, but only 22 of them participate in protein composition.

Wheat proteins (gluten and protein concentrates) are considered important resources in the food industry. Their unique properties enable the enrichment of low-gluten flour, provide elasticity and stability to dough, and improve the quality and shelf life of the final products. [1,6].

In Uzbekistan, wheat is the main cereal raw material, and its protein content can vary from 9% to 25% depending on the variety and growing conditions. Hard wheat and certain wheat varieties are distinguished by higher protein content, which is crucial for improving the quality of bread and pasta products.

Table 3

Chemical Composition of Protein Concentrates Obtained from Wheat (% of Dry Matter)

Component	Content, %
Carbohydrates	45–67 (Including starch – 25–45)
Protein (NX5.7)	25–50 (Including solubility – 5–10)
Fiber	2,5–3,4
Color	1,8–2,7

Protein concentrates are obtained by separating wheat flour suspension into starch and protein fractions. These components determine the biological and technological value of the products.

Gluten has a water absorption capacity of 170–180%. This property allows it to be used in bread and supplementary food products as a moisture-retaining and structure-stabilizing agent. [1,2,3,6].

Wheat proteins and protein concentrates are highly valuable products for the food industry in Uzbekistan, both technologically and biologically. Their application offers a range of effective opportunities:

In the production of dietary and functional foods, wheat proteins can be used as a primary component to enhance the biological value of bakery, pasta, sausage, confectionery, and other food products, as well as for specialized dietary groups (such as salt-free, low-acidity, low-protein, or low-carbohydrate products).

In improving the quality of finished bread and pasta products, protein concentrates and gluten ensure the elasticity and stability of the dough, extend the freshness and shelf life of bread, and strengthen the texture and structure of the products. [4,6].

In industry, wheat proteins play an important role as moisture-retaining, emulsifying, and foaming agents, helping to maintain the stability of product structure and texture. At the same time, they can also be used as ingredients in sausages, semi-finished products, cookies, and dietary breads.

The biological value and dietary significance of wheat proteins are enhanced due to their richness in lysine, threonine, glutamine, and other essential amino acids. They help strengthen the human immune system, support energy metabolism, and promote the synthesis of blood cells. [5,6]

CONCLUSION. Moreover, wheat proteins can be used not only in the food industry but also in cosmetics and medical fields, for example, in shampoos and conditioners for hair, as well as in the production of functional dietary products.

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