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***Аннотация.** Статья посвящена обзору рубинового шоколада, инновационного продукта, уникального шоколада розового цвета с необычным фруктовым вкусом, разработанного бельгийской компанией Barry Callebaut в 2017 году. Основные характеристики, происхождение, состав, цвет и вкусовые качества, а также технология производства рубинового шоколада рассмотрены в статье. В статье также представлен анализ тенденций рынка и мнения экспертов об уникальности рубинового шоколада.*

***Ключевые слова**: рубиновый шоколад, какао бобы, шоколатье, ягодный вкус, кислотность*

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BIOTECHNOLOGICAL PROCESSING OF KABULI CHICKPEA SEEDS BY VARIOUS METHODS FOR USE IN THE FOOD INDUSTRY

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Abstract. Chickpea seeds are a source of dietary protein ingredients with biologically active properties and functional properties. The structure of many foods is largely determined by the presence of proteins. Protein hydrolysis increases the solubility of proteins and changes their functional properties. There are various methods for breaking down proteins and converting them into biologically active peptides. Animal enzymes (pepsin and trypsin) and proteolytic lactic acid microorganisms were used in this study. Electrophoresis in polyacrylamide gel with sodium dodecyl sulfate (SDS-PAGE) was used to study the protein fractions of chickpeas. The results showed that hydrolysis of chickpea proteins by pepsin and trypsin enzymes, as well as fermentation by bacteria *Latilactobacillus sakei* SD-8 and *Levilactobacillus brevis* VY-1 significantly affect the protein profile of peas. Enzymatic hydrolysis and fermentation of chickpea proteins make it possible to create new, delicious and healthy foods in response to the current sociological and environmental problems faced by people around the world.

Key words: chickpeas, lactic acid microorganisms, enzymatic hydrolysis of protein, bioactive peptides.

Introduction. In the legume family, the chickpea (*Cicer arietinum* L.) is an annual plant that produces 16% of all legumes produced worldwide. [FAO (2020), statistics data sets FAOSTAT]. Chickpeas are typically thought to be a better source of protein and carbs than other beans, with 15–25 % of their mass coming from protein and contains 18 kinds of amino acids, 8 of which are essential [5]. Products made from processing chickpeas are frequently utilized in the meat, dairy, confectionery, bakery and other food industry sectors to determine the final product's texture and consistency. It should be mentioned that the biological value and functional qualities of chickpea seeds' proteins decide whether or not employing them and their processed products in the food sector makes sense. [1] Chickpea proteins produce bioactive peptides that have potential applications in the food industry. These are amino acid polymers that are created when proteins hydrolyze and interact with biological components to promote positive health effects. [8] Bioactive peptides are traditionally produced by enzymatic hydrolysis, fermentation, or digestion in the gastrointestinal tract [3, 7]. The purpose of this research is to hydrolyze chickpea proteins for use in the production of various food and pharmaceutical additives. To achieve these goals, chickpea isolate and extract were prepared and proteins were hydrolyzed using animal enzymes pepsin and trypsin and lactic acid microorganisms, and using sodium dodecyl sulfate-

polyacrylamide gel electrophoresis (SDS-PAGE), fraction proteins were investigated.

Materials and Methods. Chickpeas, kabuli variety, were purchased from the local market, and enzymes of animal origin, pepsin and trypsin, were obtained from HIMEDIA (India). Lactic acid bacteria *Latilactobacillus sakei* SD-8 and *Levilactobacillus brevis* VY-1 were obtained from the collection of the ROSBIOTECH.

Preparation of chickpeas for hydrolysis of proteins. To ferment chickpeas using microorganisms, chickpea milk was first prepared and after adding bacteria, incubation was done at 37 °C for 72 hours [9]. For enzymatic hydrolysis (pepsin and trypsin), chickpea protein isolates and extraction were prepared based on the method of Boye et al. [2] and Kaur and Singh [4] with modifications.

The peptide profile of chickpea samples was analyzed by one-dimensional polyacrylamide gel electrophoresis (12,5% SDS-PAGE) in a VE-20 chamber (Helicon, Russia). Electrophoregrams were stained using Coomassie R-250 (Fisher Bioreagents, England).

Discussion and conclusion. The electrophoresis pattern of chickpea protein profile indicated that, as a result of complex proteolysis of chickpea proteins, a large number of protein fragments with molecular weight less than 20 kDa were formed in the test samples, among which biologically active peptides were probably found. Research showed that microbial fermentation and trypsin and pepsin enzymes played a very effective role in hydrolysis. In the process of breaking down proteins, biochemical changes occur and proteins are hydrolyzed by proteases and as a result compounds with short chains and low molecular weight are produced. Therefore, nutritional quality, physicochemical properties, digestibility and bioactivity of substrates are improved (Figure 1).

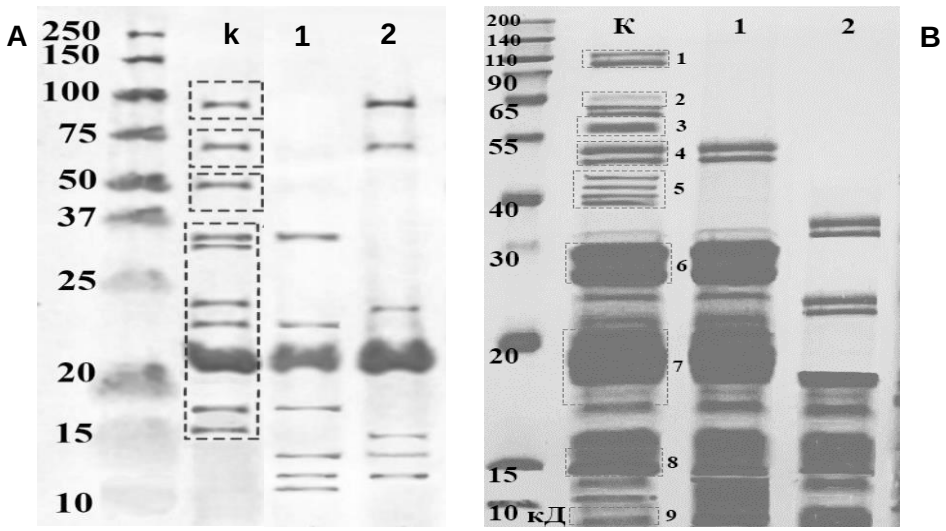

Figure 1 – A. SDS-PAGE diagram of the protein profile of chickpea (*Cicer arietinium* L.) fermented with starter cultures. Legend: St., kDa – standard Page Ruler marker; K – control, 1 – *Latilactobacillus sakei* SD-8; 2 – *Levilactobacillus brevis* VY-1. Coomassie G250 staining. B. SDS-PAGE diagram of enzymatic hydrolysates. L – Ladder (marker: 12% Tris-Glycine SDS-PAGE, 10-200 kDa, Servicebio (China)), K – control, 1 – pepsin, 2 – trypsin

According to the results obtained and the report of research results, enzymatic hydrolysis and fermentation with lactic acid microorganisms, most of the large chickpea proteins were broken down into small proteins or peptides, and chickpea protein hydrolysis can be used as functional materials in the development of new food products [6].

Chickpea protein hydrolysis can be used as functional materials in the development of new food products from chickpeas. And also their based compounds are a promising area in food technology to meet the needs of present and future consumers.

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БИОТЕХНОЛОГИЧЕСКАЯ ПЕРЕРАБОТКА СЕМЯН НУТА КАБУЛИ РАЗЛИЧНЫМИ МЕТОДАМИ ДЛЯ ИСПОЛЬЗОВАНИЯ В ПИЩЕВОЙ ПРОМЫШЛЕННОСТИ

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Аннотация: Семена нута являются источником пищевых белковых ингредиентов с биологически активными свойствами и функциональными свойствами. Структура многих пищевых продуктов во многом определяются наличием белков. Гидролиз белков увеличивает растворимость белков и изменяет их функциональные свойства. Существуют различные методы расщепления белков и превращения их в биологически активные пептиды. В данном исследовании использовались ферменты животных (пепсин и трипсин) и протеолитические молочнокислые микроорганизмы. Для исследования белковых фракций нута использовали электрофорез в полиакриламидном геле с додецилсульфатом натрия (SDS-PAGE). Полученные результаты показали, что гидролиз белков нута ферментами пепсином и трипсином, а также ферментация бактериями *Latilactobacillus sakei* SD-8 и *Levilactobacillus brevis* VY-1 существенно влияют на белковый профиль гороха. Ферментативный гидролиз и ферментация белков нута позволяют создавать новые, вкусные и полезные для здоровья продукты питания в ответ на нынешние социологические и экологические проблемы, с которыми сталкиваются люди во всем мире.

Ключевые слова: нут, молочнокислые микроорганизмы, ферментативный гидролиз белка, биоактивные пептиды.