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PROMISING LENTIL VARIETIES FOR THE PRODUCTION OF SNACK PRODUCTS IN UKRAINE

Abstract

This article presents the results of a comprehensive study of agronomic and technological characteristics of eleven food-grade lentil cultivars registered in the State Register of Plant Varieties of Ukraine, with the aim of assessing their potential for use in the production of plant-based snack products. In the context of the growing demand for high-protein and natural foods, interest in locally cultivated legumes, particularly lentils, as a functional ingredient in snack technologies is increasing. The cultivars were compared according to four key criteria: yield, vegetation period duration, protein content, and drought tolerance level. Data were obtained from the archives of the "Sort" information and reference system and official varietal descriptors. The results revealed significant variability among cultivars across all parameters. The highest values in terms of overall agronomic and technological suitability were demonstrated by cultivars Yes Maximum, Blondie, and SNIM 18, which combine high yield (up to 2.81 t/ha), elevated protein content (up to 29.5%), high drought resistance (8 points), and short or moderate vegetation periods. These characteristics are critical for the industrial application of lentils in extrusion or baking processes, as they determine the economic viability of production, texture stability, water retention, and nutritional density of the final product. The article discusses the relationship between raw material quality and finished product properties, using the example of low-end and premium extruded snack products made from corn, cereals, and legumes. This comparison emphasizes the importance of both varietal traits and post-harvest processing technologies. The study also outlines future research directions, including the examination of nutrient profiles in the leading cultivars, particularly fiber, iron, zinc, folic acid, and antinutritional compounds (such as phytates and tannins), as well as the effects of germination, fermentation, and extrusion on their chemical composition and nutrient bioavailability. The presented results provide a solid foundation for the development of innovative lentil-based snack technologies adapted to the Ukrainian market, combining high nutritional value, stable quality, and cost-effective production.

Key words: lentils, varieties, snack products, antinutritional factors, healthy nutrition, snack production technology.

Introduction

In recent years, there has been a growing interest in developing food products based on plant raw materials, especially in the segment of snack foods. Lentils (Lens culinaris Medik.) are considered one of the most promising raw materials for this purpose due to their high nutritional value, including significant protein content, dietary fiber, vitamins, minerals, and bioactive compounds. Lentils are also an important source of plant-based protein, which is especially relevant in the context of healthy and functional food trends, as well as for consumers who adhere to vegetarian or vegan diets [1,2].

The global snack industry increasingly focuses on expanding the assortment of products with improved nutritional properties [3,4]. Among plant-based raw materials, lentils stand out for their favorable amino acid composition and high adaptability to various technological processes. However, lentil cultivars differ significantly in morphological and physicochemical characteristics, which directly affect the technological suitability and sensory qualities of the final snack products.

Ukraine cultivates several lentil varieties registered in the State Register of Plant Varieties Suitable for Distribution. These varieties differ in agronomic and biochemical indicators such as yield, drought resistance, protein content, and growing season duration. Such characteristics are critically important for selecting the most suitable raw material for the production of high-quality and economically feasible snack products.

Despite the significant number of studies focusing on the general properties of lentils, there is a lack of comprehensive research dedicated to evaluating specific Ukrainian cultivars in terms of their potential for processing into snack foods. Therefore, systematic analysis of the morphological and biochemical characteristics of local lentil varieties is necessary to determine their potential in snack technology.

This study aims to identify the most promising Ukrainian lentil cultivars by comparing their agronomic and biochemical characteristics with respect to their suitability for snack production, particularly using extrusion technology. Future stages of the research will include the evaluation of technological processing methods such as germination, fermentation, and extrusion to enhance the nutritional value and reduce the content of antinutritional compounds such as phytic acid and tannins.

Literature Review

Among the leguminous crops widely cultivated in Ukraine, lentils can be classified as valuable agricul-

tural crops due to their high nutritional and biological value, not only because of their significant plant protein content but also because of their cultivation characteristics [5]. It has been established that the Ukrainian varieties Luhanchanka, Dniprovska 3, and Krasnohradska 49 differ in terms of valuable protein composition and the presence of compounds that are easily digested by the human body. The content of alkaline and alcohol-soluble protein fractions in these varieties is minimal and becomes almost undetectable after germination.

Researchers [6] studied six lentil genotypes (Altintoprak, Cagil, Meyveci, Seyran, Sultan, Yerli Kirmizi) certified in Turkey. The results showed that the Meyveci genotype is most suitable for increasing the protein content in finished products. In terms of essential amino acids (methionine and tryptophan), the genotypes Cagil and Altintoprak demonstrated the best results for improving the nutritional profile of food products.

In the study [7], the phytochemical composition and secondary metabolites of lentils (Lens culinaris) were analyzed to compare their antioxidant activity depending on seed color. Three types of lentils were selected: whole French green, whole red, and whole green. The results showed a clear separation of metabolites by type. Moreover, lentils exhibited different antioxidant activities depending on color: French green and green lentils, with higher levels of phytochemicals, had greater antioxidant activity than red lentils, which contained fewer such compounds.

In another study [8], 34 samples of Pardina lentils from different production zones in Spain were analyzed. While the nutritional parameters showed insignificant differences, the composition of phenolic compounds varied significantly among samples, affecting their functional food properties.

Study [9] investigated the genetic variability of iron (Fe) and zinc (Zn) content in 96 lentil genotypes grown in India over two years, as well as the effect of genotype-by-environment interaction. A high level of variability was revealed: Fe content ranged from 71.3 to 126.2 mg/kg, and Zn content ranged from 40.1 to 63.6 mg/kg.

In paper [10], the composition, pasting, and thermal properties of eleven green pea varieties, five yellow pea varieties, and six lentil varieties (Avondale, Brewer, Pardina, Richlea, Sunrise Red, Shasta Yellow) were examined. The authors emphasized that peas and lentils are often marketed by combining different varieties into groups by color and seed size. However, the study showed significant differences in chemical composition, pasting behavior, and thermal properties between individual varieties. This highlights the relevance of using specific varieties for defined food purposes and achieving the desired functional properties in the final product.

It is important to note that most of the mentioned studies focus on lentil varieties cultivated outside Ukraine. Since the subject of our study is specifically registered Ukrainian varieties, further analysis is based solely on the varieties listed in the State Register of Plant Varieties Suitable for Distribution in Ukraine. This approach allows focusing on the practical potential of already available domestic raw materials.

The analysis of the reviewed studies indicates considerable variability in morphological, physicochemical, and technological characteristics among different lentil varieties. Certain varieties have been found to possess higher protein content, superior amino acid profiles, enhanced antioxidant activity, or optimal technological processing properties. However, despite the existing data, a systematic approach to selecting the most suitable lentil varieties for snack production has not yet been developed [11].

Currently, there is a lack of research on which specific Ukrainian-grown varieties can ensure optimal sensory, nutritional, and technological characteristics of finished products. The absence of a comprehensive analysis of species and varietal diversity of lentils in the context of their application in the snack food industry highlights the scientific and practical relevance of further research in this direction.

Formulation of the Problem

In recent years, the food industry has demonstrated growing interest in expanding the assortment of plant-based snack products, especially those based on legumes. Lentils (Lens culinaris Medik.) are considered one of the most promising raw materials for this purpose, due to their high nutritional and biological value, rich protein content, and the presence of vitamins, minerals, and bioactive compounds. However, lentil varieties differ significantly in terms of their morphological, chemical, and technological characteristics, which directly affect the quality, nutritional properties, and functional behavior of the final product.

Despite numerous studies investigating the general characteristics of lentils, there is still a lack of systematic research focused on identifying the most suitable lentil varieties for specific technological processes—particularly for snack production. Moreover, most scientific data refer to varieties cultivated abroad, while the practical use of lentils for food production in Ukraine requires analysis of local genetic resources.

Considering these challenges, this study aims to evaluate and compare lentil varieties officially registered and cultivated in Ukraine based on key agronomic and technological criteria: yield, duration of the vegetation period, protein content, and drought resistance. The research identifies the most promising varieties for the production of plant-based snacks and lays the foundation for subsequent studies aimed at optimizing their processing, including methods such as germination, extrusion, and fermentation. The main objectives of this study are:

- To assess the agronomic indicators of registered Ukrainian lentil varieties;
- To compare selected varieties by their protein content, yield, drought tolerance, and vegetation period;
- To determine which varieties are most suitable for plant-based snack production based on functional and nutritional potential;
- To outline the future direction of research concerning the chemical composition and technological processing of the selected varieties for the reduction of antinutritional compounds and improvement of final product quality.

Materials and Methods

The study utilized data from the State Register of Plant Varieties Suitable for Distribution in Ukraine, as well as official information from the "Sort" Information and Reference System. A total of 11 varieties of food lentils registered in Ukraine were analyzed: Antonina, Blondie, Harry, Darinka, ES Maximum, Zelevyr, Linza, RED, Serpanok, SNIM 18, and Khryzolit. The following agronomic and chemical-technological indicators were evaluated for each variety:

- yield (t/ha),
- vegetation period duration (days),
- protein content (%),
- drought resistance (on a 9-point scale).

These indicators were selected as key criteria for assessing the suitability of lentil varieties for use in snack food production.

The data analysis was conducted using comparative analysis methods with the construction of tables and bar charts, which allowed for a visual comparison of the varieties by each criterion. Statistical processing and visualization were performed using Microsoft Excel and Google Sheets.

Among the selected criteria, special attention was given to those directly affecting the quality of the final product — raw materials for snacks produced by extrusion or baking (crackers). In particular, the study focused on indicators such as high protein content (to increase nutritional value), stable yield (economic feasibility), early maturity (faster production cycles), and drought resistance (reliability of cultivation under changing climate conditions).

To form a foundation for further technological improvement, the selected varieties will be used in the next stage of experimental research to study the effects of technological treatments (particularly sprouting) on their chemical composition and levels of antinutritional compounds.

Results of the Study and Their Discussion

The quality of the final snack product is largely determined by the quality of the raw material. Regardless of whether the source is legumes, cereals, vegetable powders, or extruded starch blends, the chemical composition, degree of processing, and functional properties of the raw material—such as protein and fiber content, gelling and water-holding capacity, and thermal stability—directly affect the texture, taste, and nutritional value of the finished snack. For example, in the segment of extruded corn snacks, lower-priced products are often made from refined raw materials with low nutritional value and artificial flavorings, while premium options include blends of legumes, whole grains, natural vegetable powders, and dietary fiber. These products tend to have a more porous texture, a balanced, natural taste, and higher levels of protein and beneficial nutrients. Similarly, the morphological and chemical characteristics of lentil seeds directly affect their functionality during thermal processing—such as extrusion or baking—making the selection of a suitable variety critically important for achieving consistent product quality and market positioning within a given segment.

According to the State Register of Plant Varieties Suitable for Distribution in Ukraine [12], 11 varieties of food-grade lentils are currently registered. Each of these varieties possesses unique morphological, agronomic, and technological characteristics that may determine their efficiency under different cultivation conditions and during processing into snack products. This section provides a detailed review of the key varieties relevant for snack production and compares them based on characteristics that influence their potential for use in food manufacturing.

Using data from the archives of the "Sort" Information and Reference System [13], a comparative analysis was conducted for the lentil varieties registered in Ukraine. The evaluation was based on four key criteria: yield, vegetation period duration, protein content, and drought resistance. This system provides comprehensive information about each variety, enabling a thorough assessment of their strengths and weaknesses in the context of potential application in snack production.

Comparing the varieties based on these indicators allows for the selection of optimal candidates for further use in technological processes, taking into account not only specific production requirements but also cultivation conditions and regional climate factors.

High yield is a critical characteristic when selecting a variety for commercial cultivation and subsequent use in snack manufacturing. The greater the yield per hectare, the lower the raw material cost, making production economically viable [14]. Figure 1 presents a comparative analysis of the yield of different lentil varieties, providing a visual overview of their productivity.

The highest yield was recorded for the variety ES Maximum (2.81 t/ha), making it the most promising in this category. Good results were also demonstrated by the varieties Blondi (2.60 t/ha), SNIM 18 (2.60 t/ha), Serpanok (2.43 t/ha), and RED (2.41 t/ha). The lowest yield was shown by the variety Linza (1.74 t/ha), which may complicate its use in production.

The ripening period affects the turnover speed of raw materials and their availability for production. The shorter the vegetation period, the faster the harvest can be obtained and processed. It also helps to reduce risks associated with unfavorable weather conditions. Figure 2 presents a comparative analysis of the vegetation duration of different lentil varieties, allowing for an assessment of their suitability for fast production cycles.

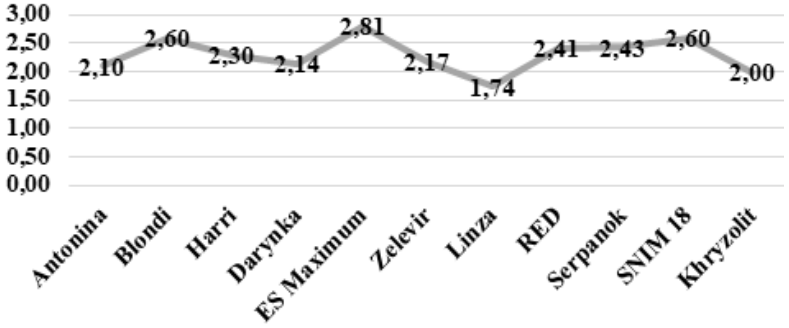

Fig. 1. Yield (t/ha) of food lentil varieties registered in Ukraine

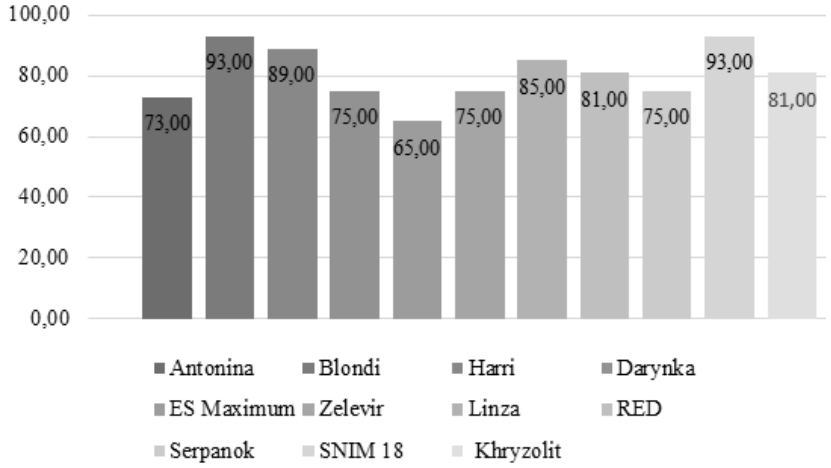

Fig. 2. Duration of the vegetation period of food lentil varieties registered in Ukraine, days

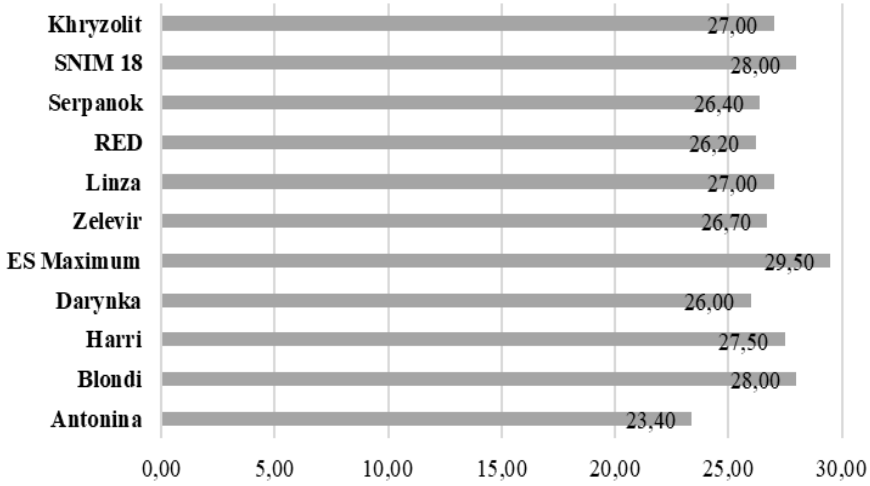

Fig. 3. Protein content in different food lentil varieties registered in Ukraine, %

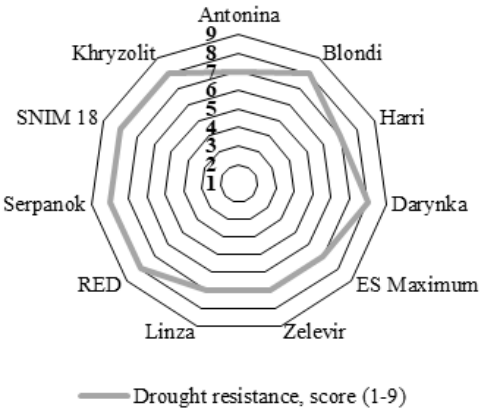

Fig. 4. Drought tolerance of food lentil varieties registered in Ukraine

The shortest vegetation period was recorded for the ES Maximum variety (65 days), allowing for a significantly earlier harvest compared to other varieties. The longest period (93 days) was observed in the Blondi and SNIM 18 varieties, which may increase the risk of crop loss due to climate variability.

Since lentils are used as a raw material for snack production, their protein composition is of crucial importance. A high protein content increases the nutritional value of the product, making it attractive to consumers seeking healthy alternatives to traditional snacks. Protein is an essential component of a balanced diet, especially
for individuals following vegetarian or vegan lifestyles. Moreover, high protein content contributes to better functional properties of the raw material, such as structural stability and water-holding capacity, which are important for forming a high-quality end product.

Figure 3 presents a comparison of protein content in different lentil varieties, allowing identification of the most promising options for the production of high-protein snacks. Selecting varieties with the highest protein content can positively influence not only the nutritional value of the final product but also its competitiveness in the functional food market.

The ES Maximum variety leads in protein content (29.50%), making it the most valuable for high-protein snack production. High protein levels were also observed in the Blondi (28.00%), SNIM 18 (28.00%), and Harri (27.50%) varieties. The lowest protein content was recorded in the Antonina variety (23.40%).

In addition to protein content, promising directions for further research include the analysis of other important nutrients in the leading varieties (ES Maximum, Blondi, SNIM 18). In particular, it is essential to assess the concentration of dietary fiber, iron, zinc, folic acid, and anti-nutritional compounds (e.g., phytates, tannins), which significantly affect the bioavailability of nutrients in snack products.

Drought resistance is one of the key factors in selecting lentil varieties for industrial snack production, as it determines the plants' ability to withstand adverse climatic conditions without significant yield reduction. In the context of global climate change, with increasingly frequent droughts, selecting varieties with high drought tolerance ensures yield stability and production predictability [15].

Varieties with a high level of drought tolerance (rated 7–9 points) tend to have more developed root systems, enabling more efficient use of available moisture. This not only ensures stable yield formation but also reduces the risk of crop loss due to unfavorable weather. Furthermore, such varieties require less supplemental irrigation, reducing cultivation costs and making production more economically viable.

Figure 4 presents a comparison of drought tolerance among various lentil varieties, helping identify the

most adaptable options for cultivation in regions with inconsistent rainfall. Using drought-tolerant varieties reduces dependency on natural conditions and ensures a stable supply of raw materials for snack production.

The highest drought tolerance score (8 points) was observed in the Blondi, Darynka, RED, Serpanok, SNIM 18, and Khryzolit varieties, making them more resilient to extreme growing conditions. Other varieties demonstrated a drought tolerance score of 7 points, which is also a good indicator, though slightly lower compared to the leading varieties.

Conclusion

As a result of the study, 11 food lentil varieties registered in Ukraine were compared according to key agronomic and technological criteria: yield, vegetation period, protein content, and drought tolerance. These indicators were selected due to their direct impact on the efficiency and economic feasibility of raw material production for the snack food industry.

The analysis revealed that the varieties ES Maximum, Blondi, and SNIM 18 demonstrated the best combination of high yield (over 2.6 t/ha), high protein content (28.0–29.5%), and technological suitability due to a balanced vegetation period and satisfactory drought resistance. These characteristics make them the most promising for use in the production of plant-based snacks, especially those obtained by extrusion or baking.

It was also found that high-protein lentils with short vegetation periods and stable drought tolerance ensure not only better nutritional profiles but also greater technological stability and process efficiency. The selection of such varieties contributes to the creation of economically viable and functionally valuable snack products with high consumer appeal. Based on the results obtained, the following areas of further research are proposed:

- Detailed study of the nutritional profiles (fiber, iron, zinc, folate, anti-nutritional factors) of the most promising varieties;
- Assessment of the effect of technological treatments (sprouting, fermentation, extrusion) on the chemical composition and bioavailability of nutrients;
- Development of a targeted technology for producing snacks from selected lentil varieties with optimized organoleptic and nutritional characteristics.

These investigations will serve as the basis for creating innovative plant-based snacks that combine high protein value, sustainability of raw material production, and consumer-oriented functional properties.

REFERENCES

1. Bernadina, O. Sochevytsia, yak perspektyvna syrovyna dlia kharchovoi i pererobnoi promyslovosti // Innovatsii rozvytku kharchovykh tekhnolohii ta industrii hostynnosti v konteksti suchasnykh tendentsii hotelno-restorannoho biznesu: zbirnyk tez I vseukr. nauk.-prakt. konf. – Ternopil, 2010. – S. 145–146.
2. Cherniakov V. A., Melnyk O. Yu. Analiz rynku snekovoi produktsii ta perspektyvy vykorystannia roslynnoi syrovyny v y ii vyrobnytstvi // Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia: Mekhanizatsiia ta avtomatyzatsiia vyrobnychykh protsesiv. – 2024. – № 2(56). – S. 108–113. – URL: https://doi.org/10.32782/msnau.2024.2.15.
3. Montejano-Ramírez, V., Valencia-Cantero, E. The Importance of Lentils: An Overview // Agriculture. – 2024. – Vol. 14, no. 1. – P. 103. – URL: https://doi.org/10.3390/agriculture14010103.
4. Chelladurai, V., Erkinbaev, C. Lentils // In: Manickavasagan, A., Thirunathan, P. (eds) Pulses. – Cham : Springer, 2020. – P. 167–188. – DOI: https://doi.org/10.1007/978-3-030-41376-7_8.
5. Atanasova V. V. Zmina vlastyvostei sochevytsi pid chas bioaktyvatsii / V. V. Atanasova // Naukovi pratsi TDATU. – 2015. – Vyp. 15. – T. 1. – S. 96–102.
6. Kahraman, A. Nutritional Components and Amino Acids in Lentil Varieties // Selcuk Journal of Agriculture and Food Sciences. – 2016. – Vol. 30, no. 1. – P. 34–38.
7. Lee, So-Young et al. Compositional Analysis of Lentil (Lens culinaris) Cultivars Related to Colors and Their Antioxidative Activity // Plant Breeding and Biotechnology. – 2017. – Vol. 5, no. 3. – P. 192–203. – URL: https://doi.org/10.9787/pbb.2017.5.3.192.
8. Liberal, Â. et al. Phytochemical and Antioxidant Profile of Pardina Lentil Cultivars from Different Regions of Spain // Foods. – 2021. – Vol. 10, no. 7. – P. 1629. – URL: https://doi.org/10.3390/foods10071629.
9. Kumar, J. et al. Analysis of genetic variability and genotype × environment interactions for iron and zinc content among diverse genotypes of lentil // Journal of Food Science and Technology. – 2018. – Vol. 55, no. 9. – P. 3592–3605. – URL: https://doi.org/10.1007/s13197-018-3285-9.
10. Li, C., Ganjyal, G. M. Chemical Composition, Pasting, and Thermal Properties of 22 Different Varieties of Peas and Lentils // Cereal Chemistry Journal. – 2017. – Vol. 94, no. 3. – P. 392–399. URL: https://doi.org/10.1094/cchem-04-16-0080-r.
11. Mazur V. A., Tkachuk O. P., Pantsyrieva H. V., Alieksieiev O. O. Sortovi resursy zernobobovykh kultur v Ukraini: suchasnyi stan i perspektyvy vykorystannia : monohrafiia. – Vinnytsia : TVORY, 2022. – 196 s.
12. Derzhavnyi reiestr sortiv roslyn, prydatnykh dlia poshyrennia v Ukraini [Elektronnyi resurs] / Ministerstvo ahrarnoi polityky ta prodovolstva Ukrainy. – URL: https://minagro.gov.ua/file-storage/reyestr-sortiv-roslin
13. Arkhivy | Informatsiino-dovidkova systema "Sort" [Elektronnyi resurs]. – URL: http://sort.sops.gov.ua/issue/archive
14. Mazur V. A., Tkachuk O. P., Didur I. M., Pantsyrieva H. V. Osoblyvosti tekhnolohii vyroshchuvannia maloposhyrenykh zernobobovykh kultur : monohrafiia. – Vinnytsia : TVORY, 2021. – 172 s.
15. Mazur, V., Didur, I., Tkachuk, O., Pantsyreva, H., Ovcharuk, V. AGROECOLOGICAL STABILITY OF CULTIVARS OF SPARSELY DISTRIBUTED LEGUMES IN THE CONTEXT OF CLIMATE CHANGE // Scientific Horizons. – 2021. – Vol. 24, no. 1. – P. 54–60. – URL: https://doi.org/10.48077/scihor.24(1).2021.54-60.

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ПЕРСПЕКТИВНІ СОРТИ СОЧЕВИЦІ ДЛЯ ВИРОБНИЦТВА СНЕКОВИХ ПРОДУКТІВ В УКРАЇНІ

Анотація

У статті представлено результати комплексного дослідження агрономічних і технологічних характеристик одинадцяти сортів харчової сочевиці, зареєстрованих у Державному реєстрі сортів рослин України, з метою визначення їхнього потенціалу для використання у виробництві снекової продукції на основі рослинної сировини. Враховуючи актуальність здорового харчування, попит на високобілкові та натуральні продукти, зростає інтерес до використання локальних бобових культур, зокрема сочевиці, як функціонального інгредієнта в технологіях виготовлення снеків. Проведено порівняння сортів за чотирма ключовими критеріями: урожайність, тривалість вегетаційного періоду, вміст білка та рівень посухостійкості. Дані отримано з архівів інформаційно-довідкової системи «Сорт» та офіційних джерел щодо сортових характеристик. У результаті встановлено суттєву різницю між сортами за всіма показниками. Найкращі значення за сукупністю досліджуваних параметрів продемонстрували сорти ЄС Максимум, Блонді та СНІМ 18, які мають найвищу врожайність (до 2,81 т/га), підвищений вміст білка (до 29,5 %), високу посухостійкість (8 балів) та короткий або помірний вегетаційний період. Такі характеристики є критично важливими для промислового використання сочевиці в технологіях екструзії або випікання, оскільки визначають економічну доцільність виробництва, стабільність текстури, вологоутримуючу здатність та харчову щільність кінцевих продуктів. Розглянуто взаємозв'язок між якістю сировини та властивостями готових снеків, на прикладі порівняння дешевих та преміальних зразків екструдованої продукції з кукурудзи, зернових і бобових. Це дозволило підкреслити важливість не лише сортових особливостей, а й подальшої технологічної обробки сировини. Також окреслено перспективи наступних етапів дослідження: вивчення нутрієнтного складу відібраних сортів, аналіз вмісту клітковини, мінералів (заліза, цинку), фолієвої кислоти та антипоживних речовин (фітатів, танінів), а також оцінка впливу пророщування, ферментації та екструзії на біодоступність поживних компонентів. Запропоновані результати створюють основу для розробки інноваційної технології виробництва снеків із сочевиці, адаптованої до умов українського ринку, що дозволить поєднати високу харчову цінність, стабільну якість та доступну собівартість.

Ключові слова: сочевиця, сорти, снекова продукція, антипоживні речовини, здорове харчування, технологія виробництва снеків.

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ANALYSIS OF EXISTING TECHNOLOGIES FOR SECONDARY PROCESSING OF GRAIN RAW MATERIALS IN BEER PRODUCTION

Abstract

The article reviews and systematizes the main modern technologies for the secondary processing of grain residues generated during beer production. The main attention is paid to brewer's grains as the most massive by-product of brewing. Traditional and innovative approaches to its storage, stabilization, drying, fermentation, bioprocessing, and use in various sectors, including feed production, food industry, bioenergy, and biotechnology, are analyzed. It is shown that the most common use of brewer's grains is in the production of animal feed due to the high content of crude protein, fiber, minerals, and essential amino acids. The article discusses in detail the technologies for drying brewer's grains, which allow to increase their