UDC 658.821
DOI https://doi.org/10.15673/gpmf.v23i2.2731

S. Sots, PhD of Technical Science, Associate Professor, *E-mail:* sotsserega@gmail.com
ORCID: 0000-0002-3267-2384; ResearcherID: G-9192-2019; Scopus Author ID: 57210357520
I. Kustov, PhD of Technical Science, Associate Professor, *E-mail: i.kustov1988@gmail.com*
ORCID: https://orcid.org/0000-0001-7632-1626, ResearcherID: I-3249-2016
O. Mashchenko, postgraduate student, *E-mail: olga1409mashchenko@gmail.com*
Odesa National University of Technology, 112, Kanatna Str., Odesa, 65039, Ukraine

PERSPECTIVES AND OPPORTUNITIES OF GROATS PRODUCTION IN UKRAINE

Abstract

Since the beginning of the 21st century, there has been an increase in the share of small enterprises in the grain industry, the number of which is increasing even today. At most of such enterprises, it is impossible to apply the existing long-term full grain processing technologies, there is a reduction in the number of basic technological operations, often not sufficiently substantiated, which affects the quality of the end products, which do not always meet all the basic norms of the regulations applicable to end products. Considering the modern technological solutions offered by leading manufacturers for the production of flaked products and quick-cooking products, it is possible to note the equipment of the Buhler company, which allows to monitor production control and, accordingly, achieve greater production efficiency. To date, the Buhler company offers the batch steamer MBDA for the steaming stage, which is recommended to be combined with the BCFB flaking machine. This technological equipment in combination gives high quality and reliability of the equipment itself, allows to implement energy-saving technologies at enterprises and obtain controlled production of quality products. Today, in addition to traditional grain, such crops as lentils, chickpeas, beans, wheat-spelt, spelt, naked varieties of oats and barley are processed in part or in small batches at the enterprises of the industry. Lentil is a promising leguminous crop for the grain industry. In the world, it is widely grown as a food and fodder crop. Among leguminous crops, lentils occupy an intermediate place in terms of protein content, with a protein content of 25-36%, while the share of carbohydrates is 45-55%, fat - 3-4%. The first variety of «Linza» edible lentils was registered in 2005. After that, the following varieties were registered only in 2017-2018: «Antonina» (2017), «Darinka» (2017), «YeSMaksymum» (2017), «Blondie» (2018), «Harry» (2018), «SNIM 18» (2018), Chrysolite (2018), which indicates an understanding of the potential of this culture both for the domestic market and for increasing the export potential of our country. The last to enter the register were «Serpanok» (2020) and «RED» (2021) varieties, which indicates the continued work of breeders to expand the varietal base of this crop in Ukraine.

Key words: traditional crops, cereal products, groats industry, flakes, flaked groats, technological equipment, Buhler equipment, Shule equipment, new crops, lentils.

Introduction

In recent years, the consumption of cereal products has been increasing in Ukraine. Rice, buckwheat and oat groats and cereal products made from them are in wide demand among the population. There is a increasing demand for instant cereals and flakes, the interest in which is primarily related to the possibility of quick preparation of these products and better nutritional and taste properties compared to traditional groats. The total potential of grain enterprises operating in our country is estimated at approximately 600,000 tons of groats and groats products per year, while the actual amount of groats produced in Ukraine was 356-397,000 tons per year [1,2,3].

In the modern world, the development and implementation of new technological solutions is taking place, which replace old and less efficient, energy-intensive long technological processes, the rapid spread of which took place in the second half of the 20th century.

The existing technologies of the grain industry of Ukraine are practically unchanged from the moment of their first widespread publication and use, the varieties of grain crops that served as benchmarks during their development cannot be compared with modern ones in terms of yield and basic properties [4].

The use of a long technological process in combination with unstable physicochemical indicators of grain raw materials does not contribute to the stabilization of high quality indicators of end products.

When developing and implementing such technologies, they primarily focused on large state-owned enterprises that occupy a significant area, consist of several components (that is, they are full-fledged milling plants that include a production elevator, a flour/groat mill, a feed mill, laboratories, etc.), require the presence of significant personnel to service all processes, while the inefficiency of technologies (incomplete use of grain potential, which for most grain crops does not exceed 60%, the rest are secondary raw materials that are not part of food products) due to the presence of a wide raw material base, relatively small cost and the low cost of electricity and other energy costs were not paid much attention, which stabilized for a long time the assortment of cereal products existing on the territory of Ukraine and almost completely stopped the development of technologies in this direction [2,4].

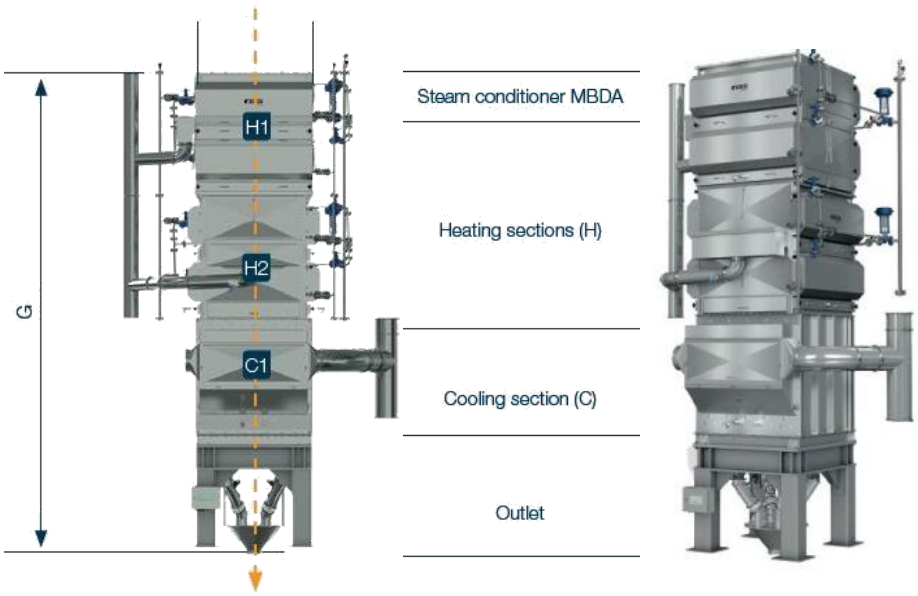
Literary review

Since the beginning of the 21st century, there has been an increase in the share of small enterprises in the grain industry, the number of which is increasing even today. At most of such enterprises, it is impossible

to apply the existing long-term full grain processing technologies, there is a reduction in the number of basic technological operations, often not sufficiently substantiated, which affects the quality of the end products, which do not always meet all the basic norms of the regulations applicable to end products.

The grain factories of Ukraine use eight main crops as raw materials for the production of groat and groats products: millet, buckwheat, rice, oats, barley, peas, wheat and corn [2].

The specified eight crops are traditional for Ukrainian groats production, their processing is carried out both at large capacity and small private enterprises. Their processing technologies are widely known to all specialists in the grain processing industry, and the range of products is defined for each crop and is perceived by consumers. Usually, the main range of processing of these crops in our country is whole groats, crushed groats, flaked groats, flakes, quick-cooking groats, cereals that do not require cooking, and flour [2,5].



G = 5,8 m – 2 t/h, G =18,4 m – 9 t/h
The steam pressure in the steamer 0.1-0.8 MPa
Fig. 1. Water-heat treatment equipment by Buhler

Formulation of the problem

Recently, there has been a trend towards increasing the production of quick-cooking products and products that do not require cooking. Such products have better taste properties and have a shorter cooking time compared to classic groats. The production of quick-cooking groats and groats that do not require cooking is provided for some traditional crops and is regulated by the Rules for conducting and organizing the technological process at groat factories (Rules), for example, the production of quick-boiling buckwheat groats [2,4].

The purpose of this stage in the processing of buckwheat is to strengthen the kernel due to heat treatment to reduce the crushing of the kernel at the stage of its dehulling and, accordingly, to increase the yield of end products, and already as a secondary effect of this stage is to reduce the cooking time of the groats and improve its taste properties for the consumer. Also, instant products can include flakes and flaked groats, the production of which is also provided for by the Rules [4]. Oats have the largest assortment of flakes and flaked products, and when processed, flaked oats, flakes "Hercules", "Pelyustkovi" and "Extra" are obtained. Instant oat products are in very high demand among consumers around the world, and thanks to this, they have become the basis for the production of more modern products such as muesli, groats with additives, multi-component groats, cereal bars. Given the high demand and good taste, today manufacturers process almost all traditional crops into flakes and instant cereals and cereals that do not require cooking. One of the most popular products today is steamed rice groats, which is characterized by an amber color and, compared to classic polished groats, is characterized by a shorter cooking time and better taste properties. The production of such groats is not accidental, because rice is able to be crushed, and to increase the output of finished products, manufacturers around the world carry out heat treatment. A typical method for our country is hydrothermal treatment, which is carried out by the method of hot conditioning or by the combined structure of cold and hot conditioning. Accordingly, for the implementation of this stage, the Rules recommend the use of continuous or periodic action steamer. At the enterprises of the industry, steamers of periodic action are more widespread [2,4,10].

Considering the modern technological solutions offered by leading manufacturers for the production of flaked products and quick-cooking products, it is possible to note the equipment of the Buhler company (fig. 1), which allows to monitor production control and, accordingly, achieve greater production efficiency. When processing classic crops, the Rules regulate the production of "Extra" oat flakes, the production technology of which is built by the Buhler company [11].

At the same time, the specified assortment of flakes is produced from a cut kernel and involves the use of more stronger modes of steaming the kernel before flaking, the steam pressure in the steamer is 0.7 MPa, while the traditional flakes "Hercules" and " Pelyustkovi" are produced by steaming the oat kernel under a pressure of 0,15-0.20 MPa [2,4]. The production of flakes from cut kernels is more widespread among the countries of the European Union, and the spread of such technologies as well as modern technological equipment will make it possible to strengthen the groats industry and provide a greater competitiveness of domestic products with European ones, and taking into account the wide raw material base that exists in the territory of our country - to in-

crease the export of flaked products and products that do not require cooking to the European and world markets. To date, the Buhler company offers the batch steamer MBDA for the steaming stage, which is recommended to be combined with the BCFB flaking machine (fig. 2).

Fig. 2. Flaking machine BCFB by Buhler

This technological equipment in combination gives high quality and reliability of the equipment itself, allows to implement energy-saving technologies at enterprises and obtain controlled production of quality products [10].

Materials and methods

Given the main problems that need to be solved, grain processing enterprises are increasingly looking for new types of grain raw materials and the latest technological equipment that can solve or reduce the influence of certain factors on the efficiency of processing. Today, in addition to traditional grain, such crops as lentils, chickpeas, beans, wheat-spelt, spelt, naked varieties of oats and barley are processed in part or in small batches at the enterprises of the industry.

Lentil is a promising leguminous crop for the grain industry. In the world, it is widely grown as a food and fodder crop. This culture has been known to mankind since ancient times and was widely used by mankind as a food grain along with wheat, barley, corn, etc.

Results of the study and their discussion

Today, lentils are grown in the world in small volumes compared to traditional crops and can be classified as niche crops to a greater extent. The volume of its cultivation in the world fluctuates at the level of up to 5 million tons annually. The main countries specializing in the cultivation of lentils are Canada, Australia, Turkey, India, Nepal, the USA. In general, this culture has a fairly wide distribution throughout the world, although European countries grow it to a lesser extent, specializing in the cultivation of traditional wheat, barley, oats, rice, etc., lentils are grown in 52 countries of the world. Given that lentils belong to leguminous crops, the main characteristic advantage of which is an increased protein content, this crop has a high export potential, it is actively exported to Asian countries, where it is widely used as a raw material for the creation of a variety of food products and a substitute for animal protein in the diet of the population of such countries like India, Pakistan, UAE, Bangladesh [12-16].

Lentils are also imported to the countries of the European Union, but in small quantities, ranging from 200 to 250,000 tons per year [16].

The main world exporter of lentils is Canada, which grows almost a third of the entire world volume of lentils. Among leguminous crops, lentils occupy an intermediate place in terms of protein content, with a protein content of 25-36%, while the share of carbohydrates is 45-55%, fat - 3-4%. According to the fractional composition of the lentil protein complex, globulins predominate, albumins, glutelins and a small amount of prolamins are also present, which is characteristic of all legumes. The amino acid composition of lentil proteins is sufficiently balanced in terms of the content of amino acids indispensable for the human body, while the absence of methionine is noted in it. Vitamins of group B, A, trace elements (calcium, iron, potassium) were found in the chemical composition of lentils. The greatest feature among all legumes is the ability of lentils not to accumulate toxic substances, which allows the production of environmentally friendly products from this grain. According to their dimensional characteristics, two types of lentils are distinguished - large-seeded and small-seeded. Large-seeded lentils from the Mediterranean have a seed diameter of more than 5.5 mm, small-seeded lentils from Southeast Asia have a seed diameter of less than 5.5 mm. As shown by studies conducted by many scientists, there are no significant differences in the chemical composition of large-seeded and small-seeded lentils. By its shape, the lentil grain stands out among other grain crops, having a rounded, flat or lenticular shape.

Small-seeded lentils are characterized by a more convex shape of the seeds. This type of lentils is the most common in the world. According to the color of the shell, the lentil grain can be green, yellow, red, brown or even black [12-19].

Lentils are not a new crop for Ukraine. At the beginning of the 20th century it was grown on the territory of our country as a niche crop in relatively small volumes, up to 100-110 thousand tons per year. But after 1940, the volume of its cultivation decreased and it gradually passed to households where it continued to be grown for its own needs. At the beginning of the 1990s, the export potential of legumes became clear, so began to return to the study and selection of such crops as soybeans, lentils, beans, etc. If consider lentils, the main breeding institution is the National Center of Plant Genetic Resources of Ukraine, which is part of the V. Ya. Yuryev Institute of Plant Breeding of the National Academy of Agrarian Sciences of Ukraine (NAAS) [20].

In Ukraine, lentils are grown mainly in forest-steppe and steppe zones. In recent years, the share of cultivated areas in our country has been increasing and amounts to 50-70 thousand hectares. Ten edible lentil varieties have been entered into the Register of varieties and plants suitable for distribution on the territory of Ukraine. The first variety of «Linza» edible lentils was registered in 2005. After that, the following varieties were registered only in 2017-2018: «Antonina» (2017), «Darinka» (2017), «YeSMaksymum» (2017), «Blondie»

(2018), «Harry» (2018), «SNIM 18» (2018), Chrysolite (2018), which indicates an understanding of the potential of this culture both for the domestic market and for increasing the export potential of our country. The last to enter the register were «Serpanok» (2020) and «RED» (2021) varieties, which indicates the continued work of breeders to expand the varietal base of this crop in Ukraine [21].

In our country, there is no official regulation on the processing of lentils into groats and groats products. However, lentil processing products are present in our trade networks and are in sufficient demand among consumers considering their usefulness and as a new type of product. At the same time, processing of lentil grain is carried out at enterprises taking into account world experience, but without taking into account the peculiarities of the grain itself, which is grown on the territory of our country. This leads to the incomplete use of the potential embedded in the grain, as well as a narrowed range of products, which to a greater extent are groats such as crushed peas or flour.

If consider the technology of processing lentils, several main options can be distinguished with the use of equipment traditional for the grain industry. One of the most modern options was developed by the German company Schule [22]. It consists in cleaning the lentil grain from impurities with the use of sieve-air separators, aspirators, destoners and triers. The equipment proposed for cleaning lentils can be called traditional and is installed at all groats factories. After cleaning, the lentils are hulled with the help of a conical and cylindrical peeling machine of the Schule company, which are a certain analogue of the peeling-grinding machine of the ZSHN type and can also be used for peeling barley, wheat, rye, spellet wheat and peas. For sorting dehulling products, a Schule sorting cylinder is used, which is a cylindrical sieve, that is, equipment similar to a burat, which is widely used at enterprises in the grain processing industry. It is also recommended to use a Schule photo separator for sorting, the use of which allows you to take into account the different colors of the lentil grain and control the color of the end products.

Today, there is already a fairly wide range of such machines that have already entered the traditional technological lines for the production of rice groats, they can be used for sorting and controlling grain by color during the processing of rice, millet, etc [22].

Given that the vast majority of products produced by domestic enterprises are intended to meet the needs of the domestic market, the annual increase in the demand for lentils in the world, the processing of products from it, potentially opens up the export of products from it to the developed countries of the European Union and Asian countries, which will allow to increase income to the state budget.

Conclusions

Considering the main directions of modern grain processing technologies in cereal production, the following conclusions can be drawn:

- today enterprises need to focus on the newest raw material base, which was not considered promising 10-15 years ago and was used for fodder purposes or was not grown at all in Ukraine;
- when introducing new technologies, it is necessary to focus on the world leaders of manufacturers of technological equipment, this will allow to produce better than today's products and to introduce energy-saving technologies more effectively;
- to produce products with a focus on quality indicators and requirements of the European Union countries, which in turn will lead to the improvement of the nutrition of the domestic consumer and will allow the export of products produced in Ukraine abroad.

REFERENCES

1. Averchev, O. V., Avercheva, N. O., & Fesenko, H. O. (2020). Stan vyrobnytstva ta kon'iunktura rynku krup v Ukraini.
2. Shutenko, Ye.I. Tekhnolohiia krup'ianoho vyrobnytstva: navch. Posibnyk [Tekst] / Ye.I. Shutenko, S.M. Sots. – K.: Osvita Ukrainy, 2010. – 272 s.
3. Lisovyi, M. M., Voroniuk, Z. S., & Palchuk, M. F. (2010). Suchasnyi stan i perspektyvy vyroshchuvannia osnovnykh krup'ianykh kultur v Ukraini. Zroshuvane zemlerobstvo, (54), 103-114.
4. Pravyla orhanizatsii i vedennia tekhnolohichnoho protsesu na krup'ianykh zavodakh. – K., 1998. – 164 s.
5. Shakalii, S. M. (2023). Doslidzhennia krup'ianoho vyrobnytstva v Ukraini. Prohramnyi komitet, 219.
6. Eliasson, A. C. (2006). Carbohydrates in food. CRC press.
7. Poliakova, K. M. (2013). Dosiahnennia ta perspektyvy selektsii sochevytsi. Visnyk KhNAU. Seriia: Roslynnytstvo, selektsiia i nasinnytstvo, plodoovochivnytstvo, (9), 220-225.
8. Chelladurai, V., & Erkinbaev, C. (2020). Lentils. Pulses: Processing and product development, 129-143.
9. Reznichenko, V. P., &Iliiash, O. M. (2015). SOChEVYTsIa, YaK DZhERELO VYSOKOIaKISNOHO BILKU. Materialy X Mizhnarodnoi naukovo-praktychnoi konferentsii. Problemy konstruiuvannia, vyrobnytstva ta ekspluatatsii silskohospodarskoi tekhniky.–Kirovohrad: KNTU, 2015.–86 s.,
10. Morhun, V. O., Sots, S. M., & Donets, A. O. (2011). Pidhotovka zerna hrechky do pererobky z vykorystanniam NVCh obrobky. Naukovi pratsi [Odeskoi natsionalnoi akademii kharchovykh tekhnolohii], (40 (1)), 11-15.
11. Buhler group [Elektronnij resurs]: https://www.buhlergroup.com/global/en/locations/Ukraine-Kyiv.html
12. Dhull, S. B., Uebersax, M. A., Kinabo, J., & Siddiq, M. (2023). Nutritional Profile, Bioactive Compounds, and Health Benefits of Lentils. Lentils: Production, Processing Technologies, Products, and Nutritional Profile, 309-338.
13. Bouhlal, O., Taghouti, M., Benbrahim, N., Benali, A., Visioni, A., & Benba, J. (2019). Wheat-lentil fortified flours: Health benefits, physicochemical, nutritional and technological properties. J. Mater. Environ. Sci, 10(11), 1098-1106.
14. Klysha, A. I., & Kulinich, O. O. (2008). Yakist nasinnia sochevytsi ta osnovni napriamky selektsii dlia yoho pokrashchennia. Selektsiia i nasinnytstvo, (96), 341-346.
15. Petkevych, Z. Z., & Melnichenko, H. V. (2016). Nut, sochevytsia–perspektyvni zernobobovi kultury dlia vyroshchuvannia na pivdni Ukrainy. Zroshuvane zemlerobstvo, (65), 104-107.
16. Ahmed, J., Siddiq, M., & Uebersax, M. A. (Eds.). (2023). Lentils: Production, Processing Technologies, Products, and Nutritional Profile. John Wiley & Sons.Sravanthi, B.

17. Jayas, D. S., Alagusundaram, K., Chelladurai, V., & White, N. D. G. (2013). Effect of storage conditionson red lentils. Journal of stored products research, 53, 48-53.
18. Faris, M. E. A. I. E., Takruri, H. R., & Issa, A. Y. (2013). Role of lentils (Lensculinaris L.) in human health and nutrition: a review. Mediterranean Journal of Nutrition and Metabolism, 6(1), 3-16.
19. Hall, C., Hillen, C., & Garden Robinson, J. (2017). Composition, nutritional value, and health benefits of pulses. Cereal Chemistry, 94(1), 11-31.
20. Orekhivskyi, V. D., Sichkar, V. I., Ovsiannykova, L. K., Mamatov, M. O., & Solomonov, R. V. (2017). SOChEVYTsIa DZhERELO ROSLYNNOHO BILKA. Grain Products & Mixed Fodders, 17(4).
21. Derzhavnyi reiestr sortiv roslyn, prydatnykh dlia poshyrennia v Ukraini [Elektronnij resurs]: https://minagro.gov.ua/file-storage/reyestr-sortiv-roslin
22. SCHULE Mühlenbau [Elektronnij resurs]: https://www.schulefood.com/en/

УДК 658.821

С.М. Соц, канд. техн. наук, доцент, *E-mail: sotsserega@gmail.com*
І.О. Кустов, канд. техн. наук, доцент, *E-mail: i.kustov1988@gmail.com*
О.І. Мащенко, аспірант, *E-mail: olga1409mashchenko@gmail.com*
Одеський національний технологічний університет, вул. Канатна, 112, Одеса, 65039, Україна

ПЕРСПЕКТИВИ ТА МОЖЛИВОСТІ КРУП'ЯНОГО ВИРОБНИЦТВА В УКРАЇНІ

Анотація

З початку 21 століття спостерігається зростання частки невеликих підприємств круп'яної галузі, кількість яких збільшується і сьогодні. На більшості таких підприємств неможливе застосування існуючих протяжних повних зернопереробних технологій, відбувається скорочення кількості основних технологічних операцій, частіше не достатньо обґрунтоване що позначається на якості отриманої продукції яка не завжди відповідає усім основним нормам діючого на готову продукцію регламенту. Розглядаючи сучасні технологічні рішення які пропонуються передовими виробниками для виробництва плющених продуктів та продуктів швидкого приготування можна відмітити обладнання фірми Buhler яке дозволяє проводити моніторинг контролю за виробництвом та відповідно досягати більшої ефективності виробництва. На сьогоднішній день фірма Buhler для здійснення етапу пропарювання пропонує пропарювач періодичної дії MBDA який рекомендують поєднувати з плющильним станком BCFB. Дане технологічне обладнання в поєднанні дає високу якість і надійність самого обладнання, дозволяє впроваджувати на підприємствах енергоощадні технології та отримувати контрольоване виробництво якісної продукції. На сьогоднішній день окрім традиційного зерна на підприємствах галузі частково або невеликими партіями переробляють такі культури як сочевицю, нут, квасолю, пшеницю-спельту, полбу, голозерні сорти вівса та ячменю тощо. Сочевиця є перспективною бобовою культурою для круп'яної промисловості. У світі її широко вирощують як продовольчу так і кормову культуру. Серед зернобобових культур сочевиця за вмістом білка займає проміжне місце за вмістом білка 25-36 % при цьому частка вуглеводів складає 45-55 %, жиру - 3-4 %. В Реєстр сортів і рослин придатних для поширення на території України занесено 10 сортів харчової сочевиці. Перший сорт сочевиці харчової Лінза було зареєстровано у 2005 році. Після чого наступні сорти було зареєстровано лише в період 2017-2018 років: Антоніна (2017 р.), Даринка (2017 р.), ЄС Максимум (2017 р.), Блонді (2018 р.), Гаррі (2018 р.), СНІМ 18 (2018 р.), Хризоліт (2018 р.) що свідчить про розуміння потенціалу даної культури як для внутрішнього ринку так і для нарощування експортного потенціалу для нашої країни. Останніми в реєстр потрапили сорти Серпанок (2020 р.) і РЕД (2021 р.) що свідчить про продовження роботи селекціонерів з розширення сортової бази даної культури в Україні.

Ключові слова: традиційні культури, круп'яна продукція, круп'яна промисловість, пластівці, плющена крупа, технологічне обладнання, обладнання фірми Buhler, сочевиця, обладнання фірми Shule, нові культури.

Received 26.05.2023 **Revised 25.06.2023**
Reviewed 07.06.2023 **Approved 29.06.2023**

Cite as Vancouver Citation Style
Sots S., Kustov I., Mashchenko O. Perspectives and opportunities of groats production in Ukraine.Grain Products and Mixed Fodder's, 2023; 23 (2, 90): 26-30. **DOI** https://doi.org/10.15673/gpmf.v23i2.2731

Cite as State Standard of Ukraine 8302:2015
Perspectives and opportunities of groats production in Ukraine. /Sots S. et al. // Grain Products and Mixed Fodder's. 2023. Vol. 23, Issue 2 (90). P. 26-30. **DOI** https://doi.org/10.15673/gpmf.v23i2.2731