



UDC 664.7

DOI <https://doi.org/10.15673/gpmf.v23i4.2741>

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. Donii, postgraduate student, E-mail: doniy.lesya99@gmail.com
Odesa National University of Technology, 112, Kanatna Str., Odesa, 65039, Ukraine

AUTHENTIC WHEAT GRAIN IS THE RAW MATERIAL FOR MODERN CEREAL PRODUCTS

Abstract

Wheat grain is one of the eight traditional crops that needs to be reviewed in terms of its processing, product range, and quality properties of the end products. Considering the Rules of management and organization at grain factories, it can be noted that the recommended raw material for the production of grain products is durum wheat, the processing of which allows obtaining the main assortment of wheat: groats "Poltavski" and "Artek". Today, durum wheat in our country are grown in a small amount compared to soft wheat, which is widely used in flour milling, therefore enterprises of the cereal industry in such conditions must either import significant volumes of durum wheat or use soft wheat as an alternative option, but taking into account the peculiarities of the produced groats and the technological process, which is built for a stronger grain, the processing of soft wheat in such conditions and the production of crushed groats "Poltavski" and "Artek" from it cannot be considered effective. A key factor in the efficiency of soft wheat processing in groats production is also the difference in the chemical composition of two types of wheat, in which soft wheat has, for example, a lower mass fraction of protein compared to durum wheat, which does not allow production from soft wheat modern products of healthy and complete nutrition, the demand for which is only growing every year in the World and Ukraine. Emmer is one of the oldest cereal crops that mankind used for food and fodder needs. Cultivation of emmer began approximately 10,000-8,000 BC on the territories of ancient Egypt, Mesopotamia, Syria, Ethiopia, as well as other countries of Asia, North Africa and the Middle East. On the territory of Ukraine, emmer was grown 5-6 thousand years BC. When processing emmer into groats, the total yield of end whole groats can be obtained at the level of traditional cereals from hulled cultures - up to 70%, and flakes in relation to unprocessed grain 60-65%. That is, it will not be possible to significantly increase the yield of finished products during the processing of emmer, and this is primarily explained by the filminess of this culture, but if compare the quality of the obtained products, the advantage is clearly for products from emmer, which is already a proven fact, for example in the countries of the European Union where the demand for products made from "original" hulled wheat, including emmer, is increasing every year. Our country has all the necessary conditions for the development of this culture and increasing the volume of its cultivation and processing into food products, which in turn can increase the export potential of our country not only in the form of raw materials, but also products from it.

Key words: groats production, emmer, chemical composition, food products, processing into groats, flaked products, new equipment.

Introduction

The groats industry is one of the most defining and leading branches of the grain processing industry of Ukraine. It is the groats industry, along with flour milling and baking, that ensures the production of products that are consumed by the population every day. Such products include traditional groats from whole, crushed kernels, flaked groats, instant groats, groats that do not require cooking, flakes and products made on their basis: flakes mixes, muesli, cereal breakfasts, cereal bars, dietary and health food products, functional products, etc. Basically, eight crops are used as raw materials for the production of the specified products, which make up the basis of the groats industry in Ukraine: millet, buckwheat, rice, oats, wheat, corn, barley and peas, at the same time, according to the volume of grain grown and the amount of products produced from it such crops as millet, to some extent buckwheat, rice and oats can be classified as niche crops today. Recently, there is a tendency to expand the raw material base used for the production of groats products, processing enterprises are increasingly processing such crops as wheat-spelt, emmer, naked varieties of oats and barley, lentils, chickpeas,

which ensures the expansion and quality properties of end products. At the same time, the processing of new raw materials is carried out according to similar principles and on the technological equipment that is available at the operating enterprises of the industry. Considering the effectiveness of such processing, it can be noted that despite the fact that the products obtained in such conditions are of sufficient quality compared to traditional products, the potential embedded by nature in the grain due to the adaptation of an outdated technological process to new high-performance raw materials is not used to its full extent, which inhibits expansion cultivation of the latest grain in the territory of our country and its mass use by all specialized enterprises of the grain industry.

Wheat grain is one of the eight traditional crops that needs to be reviewed in terms of its processing, product range, and quality properties of the end products. Considering the Rules of management and organization at grain factories, it can be noted that the recommended raw material for the production of grain products is durum wheat, the processing of which allows obtaining the main assortment of wheat: groats "Poltavski" and "Artek". Today, durum wheat in our country are grown in a small



amount compared to soft wheat, which is widely used in flour milling, therefore enterprises of the cereal industry in such conditions must either import significant volumes of durum wheat or use soft wheat as an alternative option, but taking into account the peculiarities of the produced groats and the technological process, which is built for a stronger grain, the processing of soft wheat in such conditions and the production of crushed groats "Poltavski" and "Artek" from it cannot be considered effective. A key factor in the efficiency of soft wheat processing in groats production is also the difference in the chemical composition of two types of wheat, in which soft wheat has, for example, a lower mass fraction of protein compared to durum wheat, which does not allow production from soft wheat modern products of healthy and complete nutrition, the demand for which is only growing every year in the World and Ukraine.

It is possible to solve problems related to the efficiency of wheat processing in our country, as well as to significantly improve the quality indicators of end products by increasing the level of introduction of emmer grain into domestic grain production. Emmer is one of the oldest natural forms of wheat, the characteristic feature of which is the presence of hard floral hulls on the surface of the grain that are not removed when it is threshed, as well as this hulled grain is characterized by increased kernel strength, which makes it a sufficiently suitable crop for the production of groats products. Today, emmer is already used, but in small quantities, for the production of cereals and partially flour in Ukraine.

Literary review

Emmer is one of the oldest cereal crops that mankind used for food and fodder needs. Cultivation of emmer began approximately 10,000-8,000 BC on the territories of ancient Egypt, Mesopotamia, Syria, Ethiopia, as well as other countries of Asia, North Africa and the Middle East [1]. On the territory of Ukraine, emmer was grown 5-6 thousand years BC [2]. Before the wide development of breeding areas, hulled wheat, including emmer, were the main wheats that were mostly grown locally and processed on a non-industrial scale compared to today, but with the beginning of the 20th century and the development of bioengineering, active work began on the breeding of more technological wheat grains of soft and hard wheat, which became the basis for the flour milling industry and groats industry. From the 20th century, the amount of cultivation and processing of emmer began to decrease and it practically went out of industrial production and remained in small agro-industrial holdings and households, but already from the end of the 20th century and the beginning of the 21st, interest in emmer as an organic grain for the production of biologically valuable products has revived which are still relevant today. Emmer as a raw material for food products in the World is used for the production of breakfast cereals, pancakes, groats, porridges, flakes, muesli, flour, pasta, bakery and confectionery products [3-5]. Emmer *T. dicoccum* has several subspecies: subspecies *abyssinicum* Vav, known as Ethiopian emmer, *subsp. asiaticum* Vav is known as Eastern emmer, *subsp. dicoccum*, known as European emmer, *subsp. maroccanum* Flaksb is known as Moroccan emmer [6].

The volume of emmer production in the World is insignificant compared to soft and even durum wheat, according to various estimates, it is up to 7 million tons annually, which is about 1% of the total volume of wheat production [7, 8]. In recent years, emmer cultivation areas have been concentrated in Ethiopia, India, Turkey, and Italy. [2,9]. There are no separate statistics on the cultivation of hulled wheat in Ukraine, which is due to the small volume of its cultivation. Statistically, the entire volume of hulled wheat cultivation in Ukraine is included in the statistics of common wheat cultivation. For our country, emmer is not a new grain in the Register of varieties of plants suitable for distribution on the territory of Ukraine three varieties of emmer have been entered, the first of which is the variety "Holikovs'ka" was registered in 2015, the following varieties are Yunika and Antares was registered in 2020 and 2021, respectively. That is, it can be noted that in our country, work on breeding new varieties of emmer accelerated began in the second decade of the 21st century.

Formulation of the problem

In Ukraine, the products of emmer processing are groats and flour, which are produced by some enterprises on technological lines and equipment for the processing of traditional hulled crops. At the same time, it is important to note that there are no normative State regulations on emmer processing in our country, and accordingly, the processing of this grain is carried out according to technical conditions and technological instructions developed on the basis of the experience of processing similar traditional film cultures by each enterprise separately, which leads to the inefficiency of the technological process, the unreasonableness of the quality indicators of products and the choice of the type of products for processing. It is also important to note that in Ukraine there is no regulation on emmer or hulled wheat grain, which fixes limiting quality indicators for determining the direction of grain use as food or fodder. The use of standards for wheat products when determining the quality of emmer products is also not correct, considering the much higher value of emmer compared to traditional wheat. In Ukraine, there is a need to review the current standards for wheat grain and its quality products with the introduction of limiting indicators for hulled wheat and determining their direction, a scientifically based assortment of processing products and their quality, or the development of new standards.

An important distinguishing characteristic of emmer grain, which distinguishes it from other hulled wheats, is its chemical composition, thanks to which food manufacturers once again turned their attention to it. The chemical composition of emmer, as well as other emmer wheat, due to their use as a basis for the selection of traditional wheat, is quite well studied, and today the advantages of emmer include a higher mass fraction of protein, fat, micro- and macroelements, antioxidant substances, etc.

Knowledge about the amount and quality of protein in it is important for determining the value of grain as food. First of all, the mass fraction of essential amino acids for the human body, which are not capable of synthesis from other substances in the human body and must



come to it with food, is important. It was determined that for this grain, the mass fraction of protein can reach a value of up to 23%, which is significantly higher than traditional wheat by this indicator [10]. At the same time, the amino acid composition shows somewhat similar trends to ordinary soft wheat: the limiting amino acids in emmer are lysine, threonine, leucine, tyrosine, phenylalanine, isoleucine, and valine, the mass fractions of which are not so significant in emmer grain compared to others amino acids, at the same time it is noted that emmer contains a larger number of essential amino acids compared to traditional wheat [11, 12]. Considering the fractional composition of proteins, it is possible to note the superiority of emmer grain over traditional wheat in the fraction of albumins and globulins. The mass fraction of albumins, globulins and gliadins in the protein complex of emmer is up to 39%, gliadins and glutelins up to 33% [13, 14].

The mass fraction of fat in emmer, as in traditional wheat, is insignificant and amounts to 5%, while, as in traditional wheat, fats are distributed in the grain mainly in the germ part and partially in the aleurone layer. Considering the fatty acid composition of emmer, it is possible to note a relatively smaller share of polyunsaturated fatty acids and a larger fraction of monounsaturated fatty acids in the fat complex compared to traditional naked wheat [21-23].

The largest part of the chemical composition in emmer grains, as in most cereals, is occupied by the carbohydrate complex, which traditionally contains starch, while other components such as sugars, β -glucans, dietary fibers make up a small part of the complex compared to starch. The mass fraction of starch in emmer grains does not exceed 58%, while this substance in emmer grains has its own differences compared to other cereals. Emmer starch is characterized by an increased content of amylose, has a more complex crystalline structure and, accordingly, has a tendency to be absorbed more slowly in the human body [17]. Wheat grain is one of the three cereal crops in the chemical composition of which the non-starch polysaccharide β -glucan is present. At the same time, oats and barley contain the largest fraction of this component (up to 7-8%), and for common wheat grain, the mass fraction of β -glucan usually does not exceed 1%. For emmer grain, the same trend is observed as for traditional wheat, the mass fraction of β -glucan in it is at the level of 0.37-0.50% [18]. The mass fraction of sugary substances in emmer is at the level of 2-3%, which is also typical for traditional wheat [14]. The mass fraction of dietary fiber in emmer grains, which is important for balanced human nutrition today, depending on the variety and agro-climatic growing conditions, is not significant and usually does not exceed 3% [20].

The mass fraction of micro and macroelements in the chemical composition of emmer grain is represented by various elements that are necessary for maintaining the normal functioning of all systems of the human body. The chemical composition of emmer contains such elements as Fe, Li, Mg, P, Se, Zn, Ca, while their mass fraction is greater than in traditional wheat grain [15, 16].

Vitamins are important microelements in the chemical composition of grain, given their inability to synthesize from other substances in the human body,

they must enter the body in dosed amounts with food. Emmer contains in its composition all the vitamins characteristic of traditional wheat grain, while the chemical composition of emmer contains an increased fraction of them. Also, emmer contains more bioactive compounds than common wheat, such as phenolic acids [19]. Emmer grains contain vitamin A, vitamins of group B and vitamin E, which allows us to talk about the usefulness of this grain in comparison with traditional wheat, and the best antioxidant properties of emmer are associated with the increased content of phenolic acids [19, 24, 25].

Results of the study and their discussion

Taking into account the significantly improved chemical composition of emmer grain from traditional wheat, it can be concluded that the use of this grain in groats production is quite reasonable, but processing it according to the existing even the most modernized versions of the classic technological scheme developed for common wheat is not rational. The processing of emmer grain, which is more useful in terms of chemical composition, into crushed groats "Poltavski" or "Artek" from the regulated with the Rules of the management and organization of the technological process at grain factories, will lead to the loss of the most important and important components from the product and lead to a decrease in potential of this grain and the unprofitability of its use in the grain industry. Therefore, today it is necessary to develop new technological schemes and justify the assortment of groats products for this grain. Today, the development of such solutions is at the first initial stage, taking into account the lower prevalence of emmer compared to the same wheat-spelt on the territory of our country. Analysis of open sources shows that in our country there are several possible options for processing emmer into groats, flakes and flour, and there are also solutions for processing wheat-spelt into groats, flakes and flour. It is important to note that despite the certain similarity between emmer and spelt, these are still separate multi-directional crops. Spelt is characterized by a softer grain similar to traditional soft wheat, which is not intended for the production of groats products, namely emmer is more similar to durum wheat, the grain of which is recommended as one of the options for groats production. That is, regardless of the fact that in the processing of both crops they will be combined with dehulling operation to release the valuable kernel, but it should be noted that the modes used for dehulling spelt are softer compared to emmer. And in addition, it can be noted that spelt is potentially better used for the production of higher-quality flakes, while emmer, due to its stronger structure, would be a better raw material for whole groats.

Considering the stage of emmer dehulling, it can be noted that the hulls and kernels have not grown together over the entire surface, and their part in the grain can reach 25-27%, that is, emmer dehulling can be carried out using several options of traditional equipment at once, which is typical for the vast majority of domestic enterprises in the industry: roll huller, horizontal dehuller, impact dehuller.

Taking into account the fact that not one correctly adjusted dehulling system does not give 100% of de-



hulled grain, it is necessary to provide another addition system for dehulling. Sorting of dehulling products must be carried out after each system with separation of hulled and unhulled grain. This operation, taking into account the sufficient difference in the dimensional characteristics of the kernel and grain, can be carried out either on sieves in the plansifter, or with the use of paddy machines (table separators), it is also possible to use triers at this stage.

The separated kernel is a semi-finished product that needs additional processing. It is advisable to direct it to the peeling system, which will ensure the removal from the surface of up to 1% of the components that are difficult for the human body to absorb. Peeling is advisable to be carried out on machines with abrasive surfaces, such as ZShN. Kernel after Peeling is a ready-made groats from a whole grain; it is expedient to check it on several aspiration systems for the presence of metallo-magnetic impurities and can be sent to storage in bunkers for end products or packaging.

Peeled the groats of emmer can be used for the production of flakes or other assortment of flaked products. Considering the peculiarities of this grain, it is advisable to moisten it before flaking in two stages. At the first stage, using the cold conditioning method, bring the groats to a moisture content of 16-18%, and at the second stage, using the hot conditioning method, during steaming in a periodic steamer under a steam pressure of 0.17-0.20 MPa for 3-4 minutes, increase the humidity to 19-20 %. Groats prepared in this way can be flaked on a flaking or roller machine and get flaked products with high quality.

When processing emmer into groats, the total yield of end whole groats can be obtained at the level of traditional cereals from hulled cultures - up to 70%, and flakes in relation to unprocessed grain 60-65%. That is, it will not be possible to significantly increase the yield of finished products during the processing of emmer, and this is primarily explained by the filminess of this culture, but if compare the quality of the obtained products, the advantage is clearly for products from emmer, which is already a proven fact, for example in the countries of the European Union where the demand for products made from "original" hulled wheat, including emmer, is increasing every year. Our country has all the necessary conditions for the development of this culture and increasing the volume of its cultivation and processing into food products, which in turn can increase the export potential of our country not only in the form of raw materials, but also products from it.

One of the modern ways of using emmer is the production of cereal breakfasts, multi-grain flakes and granola. Equipment for the production of which was developed by Buhler [26]. The implementation of developed technological solutions for the production of cereal breakfasts, multi-grain cereals and granola produced on the basis of emmer will allow not only to expand the existing range of products for balanced nutrition and to introduce new raw materials in the form of emmer into production, but also to increase the level of production, ensuring flexibility when using the recommended Buhler equipment, efficiency, durability and optimized use of energy, which, together with a high level of automation

of the technological process, ensures reliability and control over production [26].

For the production of cereal breakfasts, multi-grain cereals and granola, it is suggested to use grits as a raw material. In the production of multi-cereal products for mixing, it is recommended to use the Buhler Speedmix mixer (Fig. 1), which is capable of processing bulk dry substances at a speed of up to 20 mixing cycles per hour [26].



Fig. 1. Buhler Speedmix mixer

For flaking, it is recommended to use the Buhler PolyFlake flaking machine (Fig. 2), which is specially designed for the production of both single-component classic cereal flakes and for flaking a multi-component mixture in the production of multi-grain flakes, breakfast cereals, granola, etc., while ensuring maximum efficiency, energy saving and production safety products [26].



Fig. 2. Buhler PolyFlake flaking machine

Conclusions

The chemical composition of emmer is superior to traditional wheat, therefore it is a promising raw material for the domestic grain processing industry for the creation of food products with increased biological value. The peculiarity of emmer is the presence of hard floral hulls on the surface of the kernel, which in traditional wheat (naked grain) are removed during threshing, the fraction of which, depending on the type of emmer wheat, is 20-30%. In Ukraine, the regulated grain products of wheat grain processing are crushed groats "Poltavski" and "Artek", the basic yield indicators of which do not exceed 63%. The application of the existing tech-



nological scheme and regimes of processing wheat into groats for hulled types of wheat is not possible and requires revision in the direction of improving the regimes of dehulling, peeling, water-heat treatment, etc. Implementation of effective processing of emmer requires the

determination of technological features of grain of various varieties and lines, which will allow to determine the most suitable for grain processing of the (food) branch of the variety and will allow to determine restrictions for groats and non-groats use.

REFERENCES

1. Lysiuk H.M., Postnova O.M., Bohuslavskyi R.L. Perspektyva vykorystannia produktiv pererobky polby u kharchovykh produktakh / Prohresyvni tekhnika ta tekhnolohii kharchovykh vyrobnytstv restorannoho hospodarstva i to-rhivli Zbirnyk naukovykh prats, 2005, Vyp. 1.
2. Pelcharska, T.R. (2021). Osoblyvosti formuvannia vrozhaivosti psenytsi yaroї zalezno vid strokiv sivby.
3. Hanchinal, R.R., Yenagi, N.B., Bhuvanewari, G., Math, K., K, 2005. Grain quality and value addition of emmer wheat. University of Agricultural Sciences Dharwad, 63.
4. Kissing, L., Dyckb, K.E., Russellc, J., Clarkd, L., Hamelmane, J., Burns-Leaderf, S., Sendersg, S., Jonesh, J., Benschera, D., Davisa, M., Rothi, G., Zwingerj, S., Sorrellsa, M. E., Dawsonk, J. C. 2017. Evaluation of wheat and emmer varieties for artisanal baking, pasta making, and sensory quality. *Journal of Cereal Science*, vol. 74, 19-27.
5. Longin, C. F. H., Ziegler, J., Schweiggert, R., Carle, R., Wüschum, T. 2016. Comparative study of hulled (einkorn, emmer, and spelt) and naked wheats (durum and bread wheat): Agronomic performance and quality traits. *Crop Science*, vol. 56, 1, 302-311.
6. Rustamov, Kh. N., Akparov, Z. Y., & Abbasov, M. A. (2018). Novye obraztsy polby y psenychno-polbiannye hy-brydy azerbaidzhana. Rekomendovano do druku Naukovo-tekhnichnoiu radoiu Doslidnoi stantsii «Maiak» Instytutu ovochivnytstva i bashtannytstva NAAN, protokol № 2 vid 07 bereznia 2018 r. Vidpovidalnyi za vypusk: mol. nauk. spivrob. Pozniak OV, 224.
7. Dhanavath, S., & Prasada Rao, U.J.S. (2017). Nutritional and nutraceutical properties of *Triticum dicoccum* wheat and its health benefits: An overview. *Journal of Food Science*, 82(10), 2243-2250.
8. Peng J, Sun D, Nevo E. 2011. Wild emmer wheat, *Triticum dicoccoides* occupies a pivotal position in wheat domesti-cation process. *Aust J Crop Sci* 5:1127-43.
9. Liubych, V.V., Leshchenko, I.A., Storozhyk, L.I., & Voitovska, V.I. (2020). Vykhid i yakist podribnenoї krupy iz zerna psenytsi polby. *Ahrobiolohiia*, 79.
10. Stehno, Z. 2007. Emmer wheat Rudico can extend the spectra of cultivated plants. *Czech Journal of Genetics and Plant Breeding*, vol. 43, no. 3, p. 113-115.
11. Stehno, Z., & Moudrý, J. Amino acid compositon of emmer.
12. Konvalina, P., Capouchova, I., Stehno, Z., Moudrý Jr, J., & Moudrý, J. (2011). Composition of essential amino acids in emmer wheat landraces and old and modern varieties of bread wheat. *Journal of Food, Agriculture & Environment*, 9(3/4 part 1), 193-197.
13. Galterio, G., Colonna, M., Mariani, G., Novembre, G. (1999). Technological and nutritional characteristics of *Triti-cum turgidum* ssp. *dicoccum* and *T. spelta* grown in the Molise region. *Journal of Agricultural Medicine and Com-munity Health*, 129 (4), 227-234.
14. Čurná, V., & Lacko-Bartošová, M. (2017). Chemical composition and nutritional value of emmer wheat (*Triticum di-coccum* schrank): A review. *Journal of Central European Agriculture*.
15. Lachman, J.; Miholová, D.; Pivec, V.; Jir ²u, K.; Janovská, D. Content of phenolic antioxidants and selenium in grain of einkorn (*Triticum monococcum*), emmer (*Triticum dicoccum*) and spring wheat (*Triticum aestivum*) varieties. *Plant Soil Environ*. 2011, 57, 235-243.
16. Megyeri, M., Mikó, P.É.T.E.R., Rapi, S., Korozs, M., Forgo, P., & Molnár-Lang, M. (2014). Functional compounds of einkorn and emmer genotypes.
17. Galterio, G., Codianni, P., Giusti, A. M., Pezzarossa, B., & Cannella, C. (2003). Assessment of the agronomic and technological characteristics of *Triticum turgidum* ssp. *dicoccum* Schrank and *T. spelta* L. *Die Nahrung*, 47, 54-59
18. Messia M.C., Candigliota T., Arcangelis E. De and Marconi E. Arabinoxylans and β -glucans assessment in cereals Ital. *J. Food Sci.*, vol 29, 2017 P.112-122
19. Bencze, S., Makádi, M., Aranyos, T. J., Földi, M., Hertelendy, P., Mikó, P., & Drexler, D. (2020). Re-introduction of ancient wheat cultivars into organic agriculture—Emmer and einkorn cultivation experiences under marginal condi-tions. *Sustainability*, 12(4), 1584.
20. Desheva G.N., Kyosev B.N., Stoyanova S.D., Sabeva M.D. Grain quality of emmer germplasm (*Triticum dicoccon*) from the National Collection of Bulgaria. *Phytologia balcanica*. 2016. Vol. 22 (2). P. 223-232
21. Şahin, Y., & Karakas, F.P. (2022). Chemical Composition of Einkorn (*Triticum monococcum* ssp. *monococcum*), Emmer (*Triticum dicoccum*), and Spelt (*Triticum spelta*). In *Ancient Wheats* (pp. 119-145). Cham: Springer Interna-tional Publishing.
22. Kulathunga, J., Reuhs, B.L., Zwinger, S., & Simsek, S. (2021). Comparative study on kernel quality and chemical composition of ancient and modern wheat species: Einkorn, emmer, spelt and hard red spring wheat. *Foods*, 10(4), 761.
23. Akram, M.U., Yilmaz, R., Salantur, A., & Uygün, U. (2023). Bioactive compounds in lipids of selected wheat geno-types. *International Journal of Food Science & Technology*, 58(11), 6049-6058.
24. Karakas, F.P., Keskin, C.N., Agil, F., & Zencirci, N. (2021). Profiles of vitamin B and E in wheat grass and grain of einkorn (*Triticum monococcum* spp. *monococcum*), emmer (*Triticum dicoccum* ssp. *dicoccum* Schrank.), durum (*Triticum durum* Desf.), and bread wheat (*Triticum aestivum* L.) cultivars by LC-ESI-MS/MS analysis. *Journal of Cereal Science*, 98, 103177.



25. Iqbal, M.J., Shams, N., & Fatima, K. (2022). Nutritional quality of wheat. In Wheat. IntechOpen.
26. Buhler group [Elektronni] resurs]: <https://www.buhlergroup.com/global/en/industries/Extrusion-solutions/Breakfast-Cereals.html>



УДК 664.7

Соц С.М., канд. техн. наук, доцент, E-mail: sotsserega@gmail.com

Кустов І.О., канд. техн. наук, доцент, E-mail: i.kustov1988@gmail.com

Доній О.І., аспірант, E-mail: doniy.lesya99@gmail.com

Одеський національний технологічний університет, вул. Канатна, 112, Одеса, 65039, Україна

АУТЕНТИЧНЕ ЗЕРНО ПШЕНИЦІ – СИРОВИНА ДЛЯ СУЧАСНИХ КРУП'ЯНИХ ПРОДУКТІВ

Анотація

Однією із восьми традиційних культур яка потребує перегляду особливостей її переробки, асортименту продукції, якісних властивостей отриманих продуктів є зерно пшениці. Розглядаючи Правила ведення і організації на круп'яних заводах можна відзначити що рекомендованою сировиною для виробництва круп'яних продуктів є тверда пшениця переробка якої дозволяє отримати основний асортимент пшеничних круп: «Полтавські» та «Артек». На сьогоднішній день тверді сорти пшениці в нашій країні вирощуються в малому об'ємі в порівнянні із м'якою пшеницею яка широко використовується у борошномельному виробництві тому підприємства круп'яної галузі у таких умовах або повинні імпортувати значні об'єми твердої пшениці або використовувати м'яку пшеницю як альтернативний варіант, але враховуючи особливості круп що виробляються і технологічний процес який побудований під більш міцне зерно переробку м'якої пшениці в таких умовах і виробництво з неї подрібненої крупки типу «Полтавської» та «Артек» не можна вважати ефективною. Ключовим фактором ефективності переробки м'якої пшениці в круп'яному виробництві також є різниця у хімічному складі двох типів пшениць, при якому м'яка пшениця має до прикладу меншу масову частку білка в порівнянні із твердою, що не дозволяє виробляти з м'якої пшениці сучасні продукти здорового і повноцінного харчування, попит на які з кожним роком тільки зростає в Україні та світі. Вирішити проблеми пов'язані з ефективністю переробки пшениці в нашій країні, а також значно підвищити якісні показники готової продукції можна шляхом підвищення рівня впровадження зерна полби у вітчизняне круп'яне виробництво. Зерно полби відноситься до найстаріших природних форм пшениці, характерною особливістю якого є наявність жорстких квіткових плівок на поверхні зерна які не вилучаються при його обмолочуванні а також для саме цього плівчастого зерна характерна підвищена міцність ядра, що робить його достатньо придатною культурою для виробництва круп'яних продуктів. І на сьогодні зерно полби вже використовується але в незначних об'ємах для виробництва круп і частково борошна в Україні. Полба є однією з найдавніших злакових культур яке людство використовувало для харчових і кормових потреб. Культивування полби почалося приблизно 10000-8000 років до н.е. на територіях древнього Єгипту, Месопотамії, Сирії, Ефіопії, а також інших країнах Азії, Північної Африки і Близького Сходу. На території України полбу вирощували 5-6 тис років до н.е.

Ключові слова: круп'яне виробництво, полба, хімічний склад, харчові продукти, переробка в крупки, плющені продукти, новітнє обладнання.

Received 21.11.2023

Reviewed 04.12.2023

Revised 15.12.2023

Approved 26.12.2023



Cite as Vancouver Citation Style

Sots S., Kustov I., Donii O. Authentic wheat grain is the raw material for modern cereal products. Grain Products and Mixed Fodder's, 2023; 23 (4, 92): 6-11. DOI <https://doi.org/10.15673/gpmf.v23i4.2741>

Cite as State Standard of Ukraine 8302:2015

Authentic wheat grain is the raw material for modern cereal products. / Sots S. et al. // Grain Products and Mixed Fodder's. 2023. Vol. 23, Issue 4 (92). P. 6-11. DOI <https://doi.org/10.15673/gpmf.v23i4.2741>

