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PECULIARITIES OF NAKED OAT GRAIN AS A CEREAL CULTURE

Abstract

Archaeological excavations show that oats were known as early as the Bronze Age, from about 1500-1700 BC. According to various historical data, the homeland of the oat culture forms is Southern Europe, Northeast China and Mongolia. The first archeological findings of oat grain were discovered in Germany and date back to the I-VI c. In Kievan Rus oats began to grow from about the VI. For many centuries, oats have been an important feed and foof grain,and with the beginning of the twentieth century there is an increase in its use in agriculture and processing. Widespread products of oat processing in different countries of the world are groats, cereals, flour and food bran, in addition to traditional products produce instant cereals, muesli, various intended semi-finished products. Oats are also widely used in other industries: it is additionally used in the production of beer, oat milk, ice cream, bread, cookies, baby food, etc.

In Ukraine, oats are grown mainly as ancillary technical culture. The area of crops is from 5000 to 6000 km2. The main production is concentrated in Polissia and Forest-Steppe, mainly spring oats are grown, to a lesser extent semi-winter and winter forms. According to the State Statistics Service of Ukraine, the gross grain harvest in the last 5-7 years has increased and is at the level of 458 ... 616 thousand tons of grain per year. Over the past 20 years, oat production in Ukraine has been declining, due to the fact that most of it is grown for cereals, with a relatively small crop yield and high cultivation costs, even with the use of state-of-the-art agrotechnology. About 60,000 tonnes of oats are used annually to meet the needs of the domestic groats industry. Breeders have received new grains that have increased nutritional and technological value. Considering new varieties of oats, it is possible to distinguish naked forms of Avena nuda (naked oats).

In the world, naked oats is a valuable crop that has a consistently high nutritional value that allows it to be used in various industries. This type of oat is derived by the method of individual selection from a cross-hybrid population. The variety of this oat is inermis, morphologically different from the hull varieties by the structure of the spikelets, which determines the peculiarities of its quantitative and qualitative indicators

The peculiarity of naked oats is the absence of flower hulls firmly bound to the grain surface (20 ... 40% in oat hulled forms), which significantly improves its properties. The hulls in the naked varieties are soft, do not cover the grain very tightly and are almost completely separated in the process of grain harvesting and threshing.

Key words: *naked oats, technological properties, groat production, absence of flower hulls, varieties.*

Introduction. Formulation of the problem

In the modern world conditions, the development and implementation of new technological solutions is which are replacing the old and the less efficient, energy-intensive, extended technological processes that took place in the second half of the 20th century.

The existing technologies of the Ukrainian grain industry have been virtually unchanged since their first widespread publication and use, and the varieties of cereals that have served as a guide in their development cannot be compared with the modern ones in their yield and basic properties.

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

At the same time, the population's demand for groat products is much lower than for bread products (the basis of which is wheat bread making flour), which also affected the backwardness of introducing new types of raw materials and assortment. This can be traced to the fact that, for example, the total gross grain yield of oats in a certain period (in 1990) reached 1400-1500 thousand tons per year, while for nutritional needs (production of groats, flakes, flour, other products) up to 60 are used according to various estimates., although the greatest value of this grain is appear as food and for many years in the world is used not only for the creation of classic groat products, but also used as a raw material for breakfast cereals, muesli, bars, combined cereal products Components for functional foods and dietary gradual production of whose in Ukraine began only in the second half 2000.

Since the early 21st century, there has been an increase in the proportion of small businesses in the groats industry, which are increasing today. The majority of such enterprises do not allow the use of existing extended 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 obtained products, which does not always responds all the basic rules of the regulations on the finished products.

High efficiency of cereals processing, expanding the range of products and improving its quality properties is traditionally achieved due to new, breeding varieties of

traditional grain that have better properties - higher yields, lower hoodness, better chemical composition (more protein, β-glucan vitamins), which allows for a gradual reorientation of the processing plant to higher quality standards, with economic costs being minimal as a rule and technological schemes and equipment for their implementation remain virtually unchanged, the main adjustment occurs with the modes of operation of the most energy-intensive stages that are available available during processing and are considered irrational for the processing of new grain.

The current level of development of breeding technologies and the need for more efficient technologies and raw materials contribute to the emergence of new promising varieties of cereals that are increasing their potential every year. These breeding varieties include the naked (unhulled) varieties of crops, the processing of which, compared to the most promising and modern hulled varieties, has the most significant advantages in:

- ✓ energy efficiency;
- ✓ reduction and stabilization of the main links of the technological process;
- ✓ improving the quality and values of yield of end products;
- ✓ Opportunities in creating a new range of products.

With all these advantages, the use of naked grain does not require a complete restructuring of technological processes and special conditions, for the production of a standard range of products using a certain technological process, adjust the modes of operation of the necessary stages, others exclude completely.

The greatest perspective of completely replacing the conventional hulled varieties in the groats industry is the newest naked varieties of oats, which by botanical classification belong to the sowing oats Avena sativa L. of the subspecies Avena nudisativa. In terms of distribution and prevalence, naked varieties of oats are get behind the hulled ones, but their high perspective for different branches of the grain processing industry and the active work of breeders have led to the growing number of varieties every year and today they can be found on almost all continents.

The largest breeding centers for breeding new and adapting existing varieties of naked oats are located in technologically developed countries - Germany, France, Finland, USA, Canada, in the post-Soviet space one of the leading places is occupied by Russia and Belarus, in recent years, increasing attention has been paid to breeding naked oats in Ukraine. Considering the features of naked oats traditionally excrete 5-7 basic botanical varieties: *var.inermis; var.chinensis; var.maculate; var. mongolica; var.sibirica; var.gymnocarpa; var.affinis.*

Each subspecies has its own peculiarities and distribution. Among others in the world, including in Ukraine, the highest prevalence of varieties of naked oats is var. inermis. In the European countries there are also naked varieties classified as var. chinensis, in Mongolia and China - var. maculate and var. mongolica. The uniqueness of the varieties of naked oats is determined not only by the prevailing technological properties and chemical composition, but also by the fact that the known varieties of naked oats do not contain genetically modified organisms, which significantly expands the scope and, if necessary, allows them to be used even in the production of baby food.

For Ukraine, naked oats grain are not a fundamentally new crop. Naked grains variety Abel (Czech country of origin, originator Selgen, AS) were first registered in the State Register of Varieties of Plants Eligible for Distribution in Ukraine in 2000. Since that time, the number of varieties of naked oats in the country has only increased. In 2007, after passing the state variety tests, high-quality food varieties of the naked oats of German breeding "Salomon" and "Samuel" (originator of GSS Zaattsucht Saltsmünde GmbH) were registered.) and the first domestic variety "Skarb Ukrayiny". In 2015-16, varieties of naked oat "Diyetychnyy" and "Timbre" were registered (the originator ***Ukrainian Scientific Institute*** of Plant ***Breeding***" (VNIS)).

Despite the fact that naked oats grain in Ukraine was first officially registered 20 years ago, its widespread use in the production of grain products is practically excluded, there is no official separate statistics on the parts of its cultivation, there are no general state regulations and restrictive norms for the cultivation of this type of grain. Existing standards, in particular in force in Ukraine DSTU 4963: 2008 «Oats. Specifications." Does not allow, from a practical point of view, to evaluate naked oats, for example by, indicator of volume weight, the grain of naked oats, even shrunken and shriveled (which is by no means recommended for the production of groats), will prevail hulled the varieties for which the limit is set at least 450-520 g / l, with other indicators of impurity content, moisture content (which does not depend on the grain itself) may be full compliance with the values characteristic of food varieties of hulled oats.

The state regulation in force in Ukraine since 1998 ("Rules for conducting and organization of technological process at groats factories") for the implementation of cereals processing does not contain recommendations on the use of naked varieties of oats, while the features of naked oats do not allow efficient technological the process of production of groats products when applying separate modes defined for the hulled grain, which include water-heat treatment, pearling, control operations, etc. All this leads to the fact that the potential processing of naked oats in Ukraine is unprofitable and does not respond basic criteria due to which this grain is widely popular in the world.

The main value of naked varieties of oats is the high nutritional value of grain and, accordingly, the products obtained during its processing, as well as excellent physical properties, so that the technological process can be carried out according to a flexible structure, which allows not to depend on the existing conditions at the processing plant and technological equipment for the implementation of one or another stage of production and extends the possibility of its use for implementation in almost of any existing enterprises.

In morphological structure, the grain of naked oats is practically no different from the hulled varieties, while growing the kernel surface of the naked varieties are similarly covered with hard floral hulls, but in the hulled grain the flower films have a strong bond with the kernel and at one point and when harvesting and thresh-

ing grain without the use of special peeling equipment, their removal is not possible, the naked grain flower hulls do not have a strong bond with the kernel, is a component that is easily removed without the use of any technology equipment, depending on the varietal characteristics of grain and agrotechnical conditions of its cultivation, most of the flower hulls (up to 95-97 % of all the grain, without impurities) is removed in the process of harvesting and threshing (similar to modern naked wheat varieties).

Ukrainian naked varieties of oats have a declared average yield of 25-35 c / ha, which is lower compared to the stated characteristics of hulled varieties - 45-50 c / ha. Within the limits of these values for hulled varieties of oats, including hard flower hulls which, by their structure, practically do not contain components important for human nutrition, the technological process is carried out with the aim of their complete removal, the proportion of which, depending on the variety features may be 20-40 % which adds weight and increases yields. The naked oats do not have the hulls and yield characteristics considered without them into account as kernel, which together with the potential yields that can reach 40-45 c/ha brings the naked varieties closer to the hulled.

The naked oats grain like hulled kernel, is characterized by an elongated cylindrical shape; a distinctly crease is present on the ventral side of the grain. The kernel surface is smooth with a glossy shade of traditionally light color which, depending on the varietal features, can change from white to light yellow or light brown. On the surface of the bran parts there are trichomes, which similarly hard flower hulls need to be removed in the technological process. Comparing the pearled kernel of tradirional hulled oats and naked by the amount of trichomes naked contains much less, which is due to their removal during harvesting and threshing.

According to the anatomical structure, the naked oats grain, like all cereals, consists of three main parts – the bran, the endosperm and the embryo. The bran are divided into fruit and seed, in the upper layer of the endosperm is located aleurone layer. Endosperm has the highest proportion of grains, and bran the smallest.

Due to the absence of hard flower hulls, the geometric characteristics of the naked oat grain are smaller than the hulled grain of the traditional oat, although with the hulled kernel the main dimensional characteristics are almost identical: thickness 1.5-2.5 mm, width 2.0-3.5 mm , length 7-9 mm. Due to this, the grain size of this type of oats is relatively smaller compared to the grain in the hulls, but due to the lack of flower hulls, the naked grain has greater uniformity, which increases the efficiency of grain processing. It is recommended to divide the hulled grain during processing into fractions at the stage of cleaning and preparation, which increases the number of necessary process equipment of any range of products by twice, respectively energy costs, the number of service the staff, etc.

This has led to the fact that today, to save resources, the processing of traditional oats is in most cases carried out without fractionation, however, this leads to deterioration of the quality of end products. Naked oats grain does not have this problem and the technological process does not have to be fixed within two fractions; high processing efficiency without loss of quality achieved in processing a grain without fractionation by one stream.

By indicators of the volume weight and 1000 grains weight (additionally characterizing the size and evenness of the grain, its varietal features), the naked grain has the opposite of the traditional oat trends. Volume weight, of hulled grain owing to its convex-acute shape has the least value of this indicator among other cereals, at DSTU 4963: 2008 «Oats. Specifications.» for food used oats (minimum 3 class), volume weight is determined not less than 460 g/l, for naked oats grain due to absence of flower hulls contributes to a more dense packing of grain in a certain volume, which allows to obtain high values of volume weightindicator 580-700 g/l.

According to the 1000grains weight, by contrast, due to the presence of flower hulls, the grain of hulled oats is characterized by a sufficiently high 1000 grains weight of 30-45 g, while for the naked grain there are smaller values of this indicator of 25-30 g.

The relatively low values of 1000 grains weight do not reduce adaptability of naked oats grain and on the contrary emphasize the possibility of obtaining a high yield of end products during its processing.

The hoodness of naked oats grain in the almost complete absence of hard flower hulls is not a characteristic indicator, however the residual presence of hulls on the kernel surface depends entirely on the agroclimatic conditions of grain cultivation and the degree of threshing during harvesting.

To ensure high technological efficiency of processing naked oats grain, it is recommended that it be threshed in order to maximize the extraction of hard flower hulls, with the total proportion of untreshed and hulled (traditional oats) grain not exceeding 10%. Exceeding 10% reduces the efficiency of use of this type of grain, which is accordingly reflected in the decrease in the values of yield of end products and its quality properties.

The content of fine grains in accordance with the current standard determines the suitability of oat grain for food production, the amount of which is determined by the passage of a sieve of 1.8 × 20 mm (hulled grain), for grains of 1-2 grades no more than 3 %, 3 classes and for malt production - no more than 5 %. Such restrictions are important in terms of the ratio of the content of endosperm and hulls, in the fine grain the proportion of endosperm is small, the hulls contain more (compared to the main grain) its removal will not lead to abuse of the technological process and reduce the quality of production. By its dimensional characteristics, the grain of naked oats is smaller than the hull grain, so the use of the recommended sieve of 1.8 × 20 mm is recommended for batches of large grain, in other cases the sieve (1,6 - 1,7) × 20 mm with the mass fraction of the removed grain from the sieves should not exceed 5 %.

According to other indicators defined in the current standard indicators of moisture content, content of impurities, acidity naked oats grain intended for food production should satisfy the limiting values of these indicators. Only a humidity exceeding 0.5 % of the specified requirements is allowed.

Naked oat grain has all the advantages of the

chemical composition that are inherent in traditional hulled grain. The anatomical parts of the basic chemicals are unevenly distributed. The main component of the endosperm is starch and protein, the upper layer (aleurone) contains part of the protein, minerals and β-glucans and other fibers, the germ parts contain main mass fraction of fat and a certain amount of protein, the bran layer are mainly consists of difficult to digest fiber and particles of minerals. The absence of hard floral hulls in the naked oats which are the main components of fiber and other hard-to-digest components as a result of the differences in the chemical composition of the hulled and naked grains. For the production of high quality groat products that meet the restrictive of current standards content of proteins and their value for the human body is important.

Naked oats may contain a high protein content compared to other cereals, which may reach maximum levels of 21-22 %, however, for most varieties there is a lower indirect protein content of 14-16 %, Ukrainian varieties of naked oats characterized by a protein content of 12 to 16 %. Such significant differences within protein content values are the result of agro-climatic growing conditions depending on which the mass fraction of protein in the grain is capable of increasing or decreasing by 1.5-2.0 %, even within one defined variety. Among the varieties of naked oat recommended for growing in Ukraine, the highest protein content has the varieties of German breeding "Salomon" and "Samuel" - up to 16 %, the least promising can be called the Czech breed "Abel" and the Belarusian variety "Marathon" - up to 14 %. According to the amino acid composition of proteins, the grain of naked oats is complete for the human body, contains all the necessary eight essential amino acids - lysine, tryptophan, methionine, threonine, valine, phenylalanine, leucine, isoleucine.

Naked oat grain, similarly to hulled, contains a high proportion of lysine, the amount of which, when consumed with 100 g of oat products, satisfies the body's needs for this amino acid. The presence of partially substituted amino acids, arginine and histidine, allows the use of naked oats to create baby foods.

From a technological point of view, it is important for proteins, their structure, digestibility has water-heat treatment and its modes. The process of denaturation of proteins begins with the process of steaming, roasting, cooking, which are an integral part of the technological processes of grain processing when reaching a temperature of +110-120 ° C. As a result, their structure is destroyed. This affects the fractional composition, which increases the proportion of insoluble residue (scleroproteins) that is not absorbed by the human body, while accordingly reducing the number of available water-soluble fractions of protein (albumin and globulins). In addition, long-term heating of the grain undergoes amino acid reactions and free sugars (Maillard reaction), which darkens the grain surface due to the formation of melanoidins, which are also not absorbed by the human body. In aggregate, it reduces the total amount of protein and its and its suitability for nutrition.

Starch is the main energy substance in oat grain, in the endosperm is placed in the form of granules of various shapes with size characteristics from 3 to 10 microns. Oat grain starch is enclosed in a protein matrix and fats may be present on the surface of the starch grains in bound or free state. The constituents are amylose and amylopectin, which is characterized by a much higher proportion of amylopectin than amylose which does not exceed 20-25 %. It is the properties of amylopectin that determine the viscosity of oat products and their pasteurization. Naked oat grain is characterized by higher starch content than hulled grain, which, depending on the varietal characteristics and conditions of grain cultivation, is in the range of + 55-65 %. In the process of water-heat treatment under the action of moisture and temperature, the starch changes its physicochemical properties, at a temperature of +55 to 60 °C the hydrolysis processes begin, which is the result of reducing its amount in the grain or products.

A particular dietary component of the carbohydrate complex of some cereals is β-glucan. This substance is present in sufficient quantity only in barley, oats and wheat grains. In addition to cereals, β-glucan is also found in some species of algae, fungi and yeast. The substance has not been found in the human body, so its absence in most foods does not adversely affect the body, such as the absence of proteins, individual amino acids, minerals, vitamins etc.. By its structure and effect on the human body β-glucan can be attributed to valuable dietary fiber. It has been determined that β-glucans are difficult to absorb by the digestive system, and are able to excrete harmful substances from the body, which gives them biotic properties. The β-glucans of cereals are significantly different in structure from those found in mushrooms and yeast, the structure of which includes D-glucose having β-1-3 bonds; β-1-6, while cereal β-glucan is characterized by β-1-3 bonds; β-1-4. In the grain of the naked oat, β-glucan is located mainly in the aleurone layer, which is the upper layer of the grain close to the bran parts.

The mass fraction depends on the varietal characteristics and agrotechnical conditions of cultivation, while in quantitative terms, the naked grain exceeds the hulled content of β-glucan indirectly by 2-3 %. Intermediate values of the content of this component in valuable food varieties of naked grains reach up to 7%, while the value of 4-5% is characteristic of hulled grain.

In 1997, the US Food and Drug Administration identified β-glucan as a useful, 3 g daily substance for human health, combined with low saturated fat intake, to reduce the risk of cardiovascular disease, lower blood cholesterol, strengthen the immune system. Given the full nature of this component of the harmful effects of its excessive consumption was not detected.

From a technological point of view, the modes of pearling important for the preservation of β-glucan in end products in the processing of naked oats. Incorrectly selected mode will not only remove excess bran parts but also remove β-glucans, which reduces the potential value of the obtained products. The influence of water heat treatment modes on quantitative-qualitative changes in cereals β-glucan has not been sufficiently investigated, the vast majority of results indicate that the change of steaming modes on the quantitative fraction of β-glucan has no significant effect, the main changes are related to changes in solubility and viscosity.

For naked varieties of oat grains, similar to hulled, there is a significant mass fraction of fat in comparison with other cereals, which is one of the main advantages and disadvantages of oat grain. The advantages include the composition of oat fat, which has high biological efficiency, which is manifested in the presence in its composition of unsaturated fatty acids that are not synthesized by the human body and get to it only with food. The main constituents of the complex are linoleic, oleic and palmitic fatty acids, with a polyunsaturated fatty acid content of up to 75 %. At the same time, this is the main disadvantage of oat products - a significant proportion of polyunsaturated fatty acids that are unstable leads to a rapid deterioration in the quality of grain and products. If the uncessed grain is closed due to the integrity of the bran parts to the action of oxygen on the inner layers, which contributes to a certain equilibrium in the oxidation processes, the products of its processing, regardless of the assortment, are produced with a required defection of the integrity of the bran parts, which opens oxygen and accelerates the oxidation processes which is reflected in the relatively small shelf life of oat products – 4-6 months The mass fraction of fat in naked oats is higher than the value characteristic of the hulled grain and, depending on the varietal characteristics, may reach 12 %.

The major mass fraction of fat is in the embryo parts in the endosperm. Technologically, the stabilization of the processes in the fatty acid complex is achieved through the conduct of water-heat treatment, and if consider such a product as flakes, water-heat treatment is carried out twice - at the stage of preparation of grain for dehulling and preparation of groats for flaking. As a rule, the effectiveness of the processes is evaluated by the activity of lipase - an enzyme that is a catalyst for fat hydrolysis, and it is proved that the steaming of the grain/ groats at a saturated vapor pressure can reduce its activity by 7-10 times. It is technologically inappropriate for the grain of naked oats to apply the modes of water-heat treatment existing for hulled varieties, as steaming at the recommended modes (especially in the production of flakes) will lead to negative reactions in the carbohydrate and protein complexes of the grain, reducing the nutritional value of the product with no significant effect on the product. Therefore, for processing naked oat grain, it is important to choose the modes of water-heat treatment of the grain / groats, which at a sufficient level stabilize the fatty acid complex, but there are no negative reactions in other grain complexes, with special attention to be paid to pearling modes, which aim at softening or complete elimination of steaming is the effective removal of germ parts, potentially contributing to the stability of products during storage.

Fiber is a difficult to digest human body component of grain, in the production of cereal products with high quality and nutritional properties, the content of this substance is reduced at different stages of the technological process, so the content of fiber (its extraction) is structured and built technological processes. In the oat grain, the main mass fraction of the fiber is placed in the hard flower hulls and upper bran parts of the grain, trichomes.

Conclusion

For naked varieties of oats, the absence of flower hulls on the kernel surface, and the smaller number of trichomes, is the result of significantly lower content of fiber than in the hulled grain. The very low fiber content, combined with other physical and chemical benefits, is a key factor in making effective use of these benefits, as the removal of flower hulls and subsequent pearling(processing hulled grain) is accompanied by excessive formation of flour, which, except fiber, has a high protein content, β-glucans , fat, vitamins, minerals, which reduces the content of these biologically active substances and accordingly reduces the nutritional value and quality properties of the final product. Increase the availability of fiber and achieve its absorption in the body by conventional methods that can be used in groats production is not possible, for example, during the stage of water-heat treatment, which significantly changes the characteristics of the quantitative and qualitative characteristics of proteins, fats and carbohydrates practically does not change, no reactions its hydrolysis to other substances, only its swelling is observed, its mass fraction does not change.

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ОСОБЛИВОСТІ ЗЕРНОВОЇ КУЛЬТУРИ У ВИГЛЯДІ ГОЛОЗЕРНОГО ВІВСА

Анотація

Археологічні розкопки показують, що овес був відомий ще у бронзовому віці, приблизно у 1500-1700 рр. до н.е. За різними історичними даними батьківщиною культурних форм вівса є Південна Європа, Північно-Східний Китай та Монголія Перші археологічні знахідки зерна вівса посівного були виявлені в Німеччині та відносяться до I-VI в. н.е. У Київській Русі овес почали вирощувати приблизно з VI ст. н.е. На протязі багатьох століть овес був важливою зернофуражною та продовольчою культурою, а з початком XX ст. відмічається зростання об'ємів його використання у сільськогосподарському виробництві та переробній промисловості.

Широко розповсюдженими продуктами переробки вівса в різних країнах світу є крупи, пластівці, борошно та харчові висівки, окрім традиційних продуктів виробляють крупи швидкого приготування, мюслі, різні за призначенням напівфабрикати. Овес також широко використовується іншими галузями переробної промисловості: його додатково використовують при виробництві пива, вівсяного молока, морозива, хліба, печива, дитячих харчових продуктів тощо.

В Україні овес вирощують переважно як допоміжну технічну культуру. Площа посівів становить від 5000 до 6000 км^2. Основне виробництво сконцентровано на Поліссі та Лісостепу, вирощують переважно яровий овес, в меншому ступені напівозимі та озимі форми. Валовий збір зерна за даними служби державної статистики України за останні 5-7 років збільшується і знаходиться на рівні 458...616 тис. тонн зерна на рік. За останні 20 років виробництво вівса в Україні зменшувалося, що пов'язано з тим, що його більшість вирощується на зернофуражні цілі, при цьому культура має відносно невелику врожайність та потребує великих затрат на вирощування, навіть при застосуванні найсучасніших агротехнологій. Для забезпечення потреб вітчизняної круп'яної промисловості щорічно використовується близько 60 тис. т. вівса. Вчені-селекціонери отримали нові зернові, які мають підвищену харчову та технологічну цінність. Розглядаючи нові сорти вівса можна виділити голозерні форми Avena nuda (голозерний овес).

У світі голозерний овес є цінною культурою, яка має стабільно високу харчову цінність, що дозволяє використовувати його у різних галузях світової промисловості. Зазначений тип вівса виведено методом індивідуального відбору з безкросованої гібридної популяції. Різновид цього вівса інерміс, морфологічно відрізняється від плівчастих сортів будовою колоска, що обумовлює особливості його кількісних та якісних показників

Особливістю голозерного вівса є відсутність жорстких квіткових плівок, міцно зв'язаних з поверхнею зернівки (20...40 % у плівчастих форм вівса), що значно покращує його властивості. Плівки у голозерних сортів м`які, не щільно охоплюють зернівку і практично повністю відокремлюються в процесі збирання та обмолочування зерна

Ключові слова: *голозерний овес, технологічні властивості, виробництво крупи, відсутність квіткових оболонок, сорт.*

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