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<sup>1</sup>I. Gaponyuk, Doctor of Technical Sciences, Professor, E-mail: [nuft2016@gmail.com](mailto:nuft2016@gmail.com)  
<https://orcid.org/0000-0002-1323-0548> 2

<sup>2</sup>O. Gaponyuk, Doctor of Technical Sciences, Professor, E-mail: [oleg\\_odessa@me.com](mailto:oleg_odessa@me.com)  
<https://orcid.org/0000-0002-9577-4417>, RESEARCHERID.com/rid/U-7792-2017

<sup>2</sup>G. Goncharuk, Ph.D., Associate professor, E-mail: [ganna.goncharuk22@gmail.com](mailto:ganna.goncharuk22@gmail.com)  
<https://orcid.org/0000-0002-8361-0810>, RESEARCHERID.com/rid/U-7642-2017

<sup>1</sup>Department of Grain Storage and Processing Technology,

<sup>1</sup>National university of food technologies, 68 Volodymyrska str., Kyiv, 01601, Ukraine

<sup>2</sup>Department technological equipment for grain production

Odesa National University of Technology, 112, Kanatna Str., Odesa, 65039, Ukraine

## GRAIN PROCESSING PRODUCTS IN RATIONAL HUMAN NUTRITION

### Annotation

Due to the fact that products of plant origin are widely used by all contingents of the population and are mandatory in rational nutrition due to the significant content of vitamins, minerals, complex carbohydrates, specific substances, the topic of their use in rational nutrition needs even more careful study. It also requires attention due to the fact that it is important for doctors to know the peculiarities of the composition and properties of bread, bakery products, cereal products, legumes and other products of grain processing, their general and specific effects on the body, an appropriate combination of the possibility of giving them certain properties with the help of dietary cooking techniques for their effective use in rational, curative, curative and preventive nutrition. The article reveals the concepts, content and requirements for rational human nutrition, taking into account the specific needs of different groups of consumers. The urgency of harmonizing the nutrition structure in terms of energy and quality components with changes in the ecological state of the environment and the sharpening of the moral and ethical sensitivity of society to livestock sources of nutrition is noted. The attention is focused on the growing problem of the ecological component of the industrial industry of the products of animal husbandry complexes and the search for a compromise in the increased production of products of plant origin, an expanded range of grain processing products, the selective use of their anatomical components and the application of technologies of different depth of their processing. In addition to the ecological component of the advantages of plant products over animal products, the economic and qualitative expediency of this is also given. In particular, it was noted that the selective use of various anatomical components of grains can change the energy value of food products by 1.5-2.0 times, several times – the content of vitamins, microelements and biologically active components, such as enzymes or enzymes. In addition, using advanced processing technologies, it is possible to significantly control the nutritional value of grain products, namely, a several-fold increase in the content of dextrins or pasteurized starch grains. The possibility of combined use of various grain crops in combination with the specified technologies of their in-depth processing makes it possible to provide products with preventive and curative properties. A positive trend of intensification of the domestic grain industry and growth of its scientific potential was noted. That is why such vegetable sources of human nutrition as grain products, in combination with various technologies of their processing, should be used to cover the shortage of sources of products of animal origin, to reduce the negative impact of animal husbandry activities on the ecosystem of the planet, and to use them differently in the nutrition of consumers, taking into account the peculiarities of activity their vital activities or age status, as well as to improve the availability of food products for socially vulnerable sections of the population.

**Keywords:** grain, cereals, nutritional value, quality, energy, ecology, nutrition, technologies.

### Formulation of the problem

The potential of the domestic agrarian industry allows to grow grains four times more than the state's internal need for them. In addition, the two-fold reserve of production capacities of grain processing enterprises in combination with the scientific potential of domestic food universities can satisfy the current and prospective needs of the population of a number of countries in socially significant food products, increase the gross domestic product and profitability of enterprises. It is possible to increase the potential of using the production capacities of domestic enterprises by expanding the assortment of food products and their components. Such a direction can be scientifically balanced use of various grain and anatomical constituents of grains with given technologies of their processing to improve the social significance or availability of targeted food products, taking into account the characteristics of different age groups and the activity of the consumer's life, as well as providing such products with therapeutic and preventive properties. In

the technological schemes of the majority of domestic flour mills, grain mills and compound fodder enterprises, wet-heat and specified types of deformation methods of processing are provided.

**The purpose of the work:** the socio-ecological expediency of increasing the share of grain products of various processing technologies in the human diet.

### Materials and methods

Analytical and applied using traditional scientific methods of research, the results of well-known and proprietary methods and experimental data on changes in the chemical composition of grains, in particular, an increase in the content of dextrins and starch grains that are not pasteurized by wet-heat processing technologies, IR irradiation, extrusion, flattening, and others.

### Introduction

Today's socio-ecological challenges force us to reconsider the food culture, leveling the ideological dif-



ferences of the sacred "Eat - to live" or "Live - to eat". Why, even G. Heinove's "A man is what he eats" is leveled due to the dominance of the narrative of functional nutrition and social and ecological challenges. Issues of rational human nutrition acquire a new meaning in the context of the use of functional food products, which appear as a compromise of different views on the subject and function of food. At the same time, at present, rational nutrition embodies functional nutrition to a certain extent and levels the differences, minimizes the difference between different groups of consumers of these products. The deepening of knowledge about grain and the improvement of grain products technologies allow making changes to the traditional scale of full-fledged and even prestigious nutrition. And the ecological challenges and demographic risks of our planet make us reconsider the concept of food sources and expand the range of food, if not for all of humanity, then at least for a larger part of it. In this context, grain products do not act as a supplement or even as an alternative to products of animal origin, but the only possible solution to eliminate the shortage of food products, moreover, in combination with the leveling of environmental risks of animal husbandry.

#### Content of research

The energy value of various fruits of vegetable origin, depending on their chemical composition, varies in a wide range from 16 MJ/kg of grain and leguminous crops to 29 MJ/kg of oil crops [1, 3, 6, 8, 13, 14]. In addition, the significant difference in the chemical composition of various anatomical components of grains also determines their differences in energy and nutritional value. Such a variety of the chemical composition of plant fruits and their anatomical components makes it possible to selectively use these differences to meet the individual needs of various food consumers. In particular, repeatedly control the content of vitamins, microelements and biologically active components such as enzymes or enzymes.

In addition, advanced processing technologies can also significantly control the nutritional value of grain products [3, 5, 6, 7, 14], including multiple changes in the content of dextrins or pasteurized starch grains [12-14]. Grain products using different technologies of their processing can cover the shortage of products of animal origin, weaken the negative impact of animal husbandry activities on the ecosystem of the planet, improve the availability of food products to socially vulnerable segments of the population, and also provide these products with preventive and curative properties [1, 3, 4-14].

For a balanced establishment of the rational composition of a person's food, one should take into account not only the chemical composition of his body (Table 1), but also the peculiarities of the body's needs for its full functioning, as well as the mechanism of absorption of food components by the digestive organs [1, 3, 4-14]. Taking this into account, a balanced diet based on groups of chemical compounds such as proteins, carbohydrates, fats, and minerals is generally accepted as presented in Table 1 [3, 8, 14]. From the same table 1, we can note a certain similarity in the chemical composition

of rational food and wheat grain, except for the fat content.

**Table 1 – Chemical composition of the human body, diet and wheat grain, % [1 – 3, 8, 14]**

№	Chemical element	Human body	Rational nutrition	Grain
1	Water	60		14,0
2	Protein	20	13	12,0 – 16,0
3	Carbohydrates	1	60	55,0 – 65,0
4	Fats	14	26	1,5 – 2,4
5	Mineral speeches	5	1	2,1 – 2,5
	Total	100	100	100

In fact, it is precisely for the full-fledged formation and maintenance of vital activity that the body needs a variety of chemical compounds, in different quantities and forms, both for independent use and in various compounds and ways of use. They include 7 most influential groups [1, 3, 4 – 13]. These are proteins, fats, carbohydrates, nucleic acids, ballast substances, vitamins and mineral substances of multifunctional purpose for the formation and vital activity of the body. It is obvious that even with the similarity of the chemical composition of grain products with rational human nutrition, the body's needs can only be met by combining different products. Taking into account the above analysis of the potential opportunities of grain products to satisfy human needs for food, we suggest below to perform simple calculations on the state of food supply for the population of our planet.

Based on the energy needs of the human body and its active functioning, below are calculations of the annual need for food products of the population of our planet in terms of grain products. For example, if the average daily energy requirement from food per person is approximately 12 MJ with moderate physical exertion, then based on the current population of our planet (in 2022) (7,950 million people) it will be 34.8 · 10<sup>12</sup> MJ/year. Taking into account the chemical composition of cereals and their energy capacity, taking into account the technological output of the finished products of a grain processing enterprise, the annual human need for food products in grain equivalent amounts to approximately 2,570 million tons. Taking into account the reported data of the FAO (UN) on world cultivation in the current (2021/2022 year) of grains in the amount of 2,799 million tons, with a market demand for them of 2,785 million tons, a seemingly optimistic assessment is made with the food supply of mankind in food products, even without taking into account energy from other sources of food, such as animal origin, as well as vegetables, fruits, seafood, etc.

On the other hand, according to the same information sources, 861 million people, or every ninth inhabitant of the planet, suffer from a shortage of food energy in the world this year. Under the conditions when the projected world population reaches 9.7 billion people in 2050, the share of people who will suffer from food shortages will definitely increase rapidly by at least  $(9.70 - 7.95) / 0.86 = 2,61$  for 2.6 billion people, or up to 27% of the population of our planet. The given calculations testify to the irrational use of plant products, in particular



for the supposed needs of the functioning of livestock farms. However, is it really so? And can domestic grain processing enterprises take advantage of the complex situation of food energy deficit and its imbalance in terms of nutrients by increasing the unused potential of their production capacities?

First of all, again, we offer a little light economy on the feasibility of using products of animal origin. According to German scientists, the analysis of the necessary areas for the operation of livestock farms and the ratio of rotation of feed into livestock products proves the disappointing conclusion that the potential of the livestock industry of food products is currently at the limit of its extensive capabilities. In addition, with the development of social relations of an industrial society, today we cannot ignore the position of vegetarians regarding the inhumane use of animal food, aggravated by the economic impracticality of 30-40 times overspending of the equivalent of its production from plant products, as well as critical pollution of up to 40% of the environment by the results of animal life namely the food industry [4, 8 – 10].

All this together determines the urgent need to revise the concept of the world food industry, to change the structure of the sources of meeting the needs of mankind in food products.

Along with the energy component of the human diet, its qualitative composition is even more relevant. Below, in the table. 2 and 3 [3, 8 – 10, 14] outline the main consequences of the deterioration of the human body, associated with violations of the nutritional (quality) balance of food.

By themselves, the tabular data below are quite telling and probably do not need lengthy explanations. Instead, we will note only two, in our opinion, the most important factors. First of all, public health problems are directly related to nutrition and are inherent not only in economically underdeveloped countries, with their food shortages, but also in industrialized, economically successful countries, with their overburdening and nutritionally unbalanced diets (tables 2, 3) [3, 8 – 10, 14].

From column 4 of table 3 we can note that, if not all, then most of the diseases associated with a violation of the nutritional balance of human nutrition can be prevented by the selective use of a mixture of various cereal fruits and their anatomical components.

For the given management of the nutritional value of food products for the prevention of certain diseases below in the table 4 and 5 show the averaged indicators of the chemical composition of the most common pea, leguminous and oilseed crops and their anatomical components of wheat grain, respectively.

As we can see from the table 4 data, the highest energy value corresponds to sunflower seeds:  
 $Q=36 \cdot 54.5/100+21 \cdot 18.5/100+19 \cdot 20.2/100=27.3$  MJ/kg, (1)

And the smallest is a buckwheat grain:  
 $Q=36 \cdot 3.1/100+21 \cdot 13.1/100+19 \cdot 67.8/100=16.8$  MJ/kg, (2)

Thus, by combining the composition of various fruits of grain, leguminous or oil crops, we can manage the *energy value* of a person's diet according to his social activity, age group or other characteristics.

**Table 2 – Consequences of a violation of the energy balance of nutrition [3, 8 – 10, 14]**

Eating disorder	Consequences	Geography
Malnutrition	Exhaustion of the body, weakening of immunity, slowed growth of children, impaired well-being and activity, higher risk of diseases, with fatal consequences of up to 50% due to malnutrition	Central and North Africa, the Middle East, South Asia, the countries of the Caribbean
Overeating	Excess weight, cardiovascular disease, high blood pressure and the risk of heart attack, diabetes, tooth decay, disorders of the alimentary tract, liver disease and various forms of cancer, more than half of the premature deaths of people under the age of 65 are related to nutrition of diseases	Industrially developed countries, countries of Central and some Eastern Europe

**Table 3 – Consequences of a violation of the nutritional balance of food [3, 8 – 10, 14]**

№	Morbidity and its consequences	Reasons	Methods of elimination
1	fatigue, headaches	B2 (pantothenic acid)	embryo, yolk, legumes, fish
2	nyctalopia	A (retinol)	corn, fish oil, vegetables, fruits
3	anemia	B2 (folic acid)	wheat germ, liver
4	muscle atrophy	E (tocopherol)	wheat germ, oat flakes, bran
5	rickets	D - ultraviolet,	Fish Oil
6	blood clotting	K (phylloquinone)	
7	beriberi (weakness, loss of appetite, increased excitability, heart attack)	B1 (thiamine)	bran products, liver, legumes
8	weakening of immune protection	complex of vitamins	various food products
9	protection against cancer	Reasons	



**Table 4 – Chemical composition of grain and seeds (in % of completely dry matter, [1, 2, 7])**

Culture	Proteins	Fats	Carbohydrates	Fiber	Ash
Wheat is soft	13,9	2,0	79,9	2,3	1,9
Wheat is hard	16,0	2,1	77,4	2,4	2,0
Rye	12,8	2,0	80,9	2,2	2,1
Barley	12,2	2,4	77,2	5,2	2,9
Corn	11,6	5,3	78,9	2,6	1,5
Oat	11,7	6,0	68,5	11,5	3,4
Fig	7,6	2,2	72,5	11,8	5,9
Millet	12,1	4,5	69,8	9,2	4,3
Buckwheat	13,1	3,1	67,8	13,1	2,8
Pea	24,0	2,7	62,9	5,5	2,8
Bean	26,9	2,4	62,8	4,2	3,8
Soy	40,1	22,5	23,5	9,1	4,8
Lentil	28,1	2,0	61,8	4,6	3,2
Sunflower	18,5	54,5	20,2	3,2	3,4

On the other hand, taking into account the difference in the chemical composition of various anatomical components of grain (Table 5), their selective use in the calculations of the composition of rational nutrition, it is possible to control the *therapeutic and preventive properties* of a given diet. Taking into account the specific needs of not only age groups or physical activity, but also the state of health.

The preventive and curative function of food to eliminate food-related diseases is quite diverse. In this aspect, it is the products of grain processing that play almost the most significant role in human nutrition, which is based on their affordability, the largest share of use in the diet, the wide range of energy value of grain products of different chemical composition and the various content of therapeutic and preventive substances contained in different anatomical constituents of cereals of different groups of cereals.

In the presence of modern computer technologies and thorough studies of the chemical composition of grains of various groups and their anatomical components, today it is no longer difficult to calculate the rational diet of the consumer according to his individual characteristics in the need for nutritional, therapeutic and preventive substances.

For example, let's take wheat grain, one of the most widely consumed grain crops in the world. From the chemical composition of various anatomical components of wheat grain shown in Table 5 and their therapeutic and preventive properties shown in Tables 3, 6 and 7, by combining the components of these anatomical components and varying their content, we can change not only the chemical composition and nutritional value of the obtained mixture, as well as curative and preventive properties.

The data of Tables 6 and 7, as well as the previous ones, prove the expediency of wider use in prophylactic and curative nutrition of specified mixtures of various pea, leguminous and oil crops, individual anatomical components of their grains, both in native and technologically processed forms, with the addition of fruits and other vegetable products.

So, as we were able to see from the above data, the potential of grain products in human nutrition is not limited only to their energy value. Their selective use can prevent, and even treat, a number of diseases characteristic of the human body. In particular, such as overweight, indigestion, atherosclerosis, anemia, gallstone disease, loss of appetite, increased excitability, cardiovascular disorders, muscle atrophy, fatigue, headaches.

**Table 5 – Distribution of chemical substances in anatomical components of wheat grain [1, 7, 11, 14]**

Chemical elements	Fruit membranes, %		Seed membranes, %		Aleurone layer, %		Endosperm, %		Embryo, %	
	to the grain	to the shells	to the grain	to the shells	to the grain	to the aleurone layer	to the grain	to the endosperm	to the grain	to the endosperm
Moisture	0,5	11,2	0,13	11,8	1,03	11,8	11,26	13,20	0,16	11,2
Cellulose	3,5	78,6	0,73	66,3	4,29	48,8	0,24	0,28	0,45	31,41
Protein	0,35	7,8	0,18	16,3	2,2	25,0	8,6	10,10	0,56	39,2
Ash	0,09	2,4	0,06	5,6	0,48	5,3	0,40	0,47	0,08	5,6
Fat	--	--	--	--	0,8	9,7	0,79	0,94	0,18	12,6
Starch	--	--	--	--	--	--	62,91	75,01	--	--
In total	4,45	100	1,10	100	8,8	100	84,2	100	1,43	100



**Table 6 – Chemical composition of fruits and cereals [2, 3, 6, 7, 8, 10, 12]**

Names	Proteins (N), %	Fats (S), %	Carbohydrates (C), %	Minerals, %	Ballast substances, %	Moisture, %
Fruits (generalized)	1	0,3	8	1	3,7	86
Crops	8 – 15	2,2 – 6,0	65 – 80	2,2 – 3,2	8 – 18	12 – 15

**Table 7 – Vitamin content in fruits and cereals [2, 3, 6, 7, 8, 10, 12]**

Products	A Chicken blindness, skin peeling	C Scurvy, immunity	B <sub>1</sub> Beri-beri	B <sub>2</sub>				B <sub>6</sub> Convulsions, excitement, skin	B <sub>12</sub> Severe anemia	D Rickets	E Reproduction	K Skin folds
				riboflavin	nicotina-mide	folic acid	panto-thenic acid					
Fruits, vegetables	high	high	traces	traces	traces	traces	traces	traces	traces	traces	traces	high
Cereals, legumes, oilseeds	high	traces	high	high	high	high	high	high	traces	traces	high	traces

CLEAN PRODUCTS: TECHNOLOGY AND QUALITY

All this is a far from complete list of diseases that can be prevented and treated by selective anatomical components of grains of different groups of grains, their given combination and the use of advanced technologies for managing the nutritional properties and biochemical activity of grain products.

And the data given in the table. 8 also prove the possibility of prevention, and even treatment of many common diseases associated with nutritional disorders, easily available and relatively inexpensive components of grain.

It seems that supermarkets will have to install a few additional consumer shelves with functional food products for targeted preventive and therapeutic use. In particular, those with increased or decreased energy value, suffering from beriberi, overweight, cardiovascular or high blood pressure, headaches, etc. (see Table 3).

A completely justified question arises: are domestic flour mills, grain mills and compound fodder enterprises able to join the issues of production of curative and preventive grain products? Are there enough scientific developments of domestic scientists on these issues? And the answer is only yes! The technological schemes of grade grinding of 159 domestic mills provide for the use of wet-heat treatment methods [12]. And actually, the technological scheme itself provides for the separation from the grain of its anatomical components indicated in

**Table 8 – Prevention of some diseases with food products [3, 8 – 11]**

Diseases	Food	Content of active (ballast) substances
Atherosclerosis	Oat flakes, rye bread	9,5% (14,1%)
Overweight	Bran products	(49,5 %)
Gallstone	Bread (buns) with bran	7 % (3,5 %)
Hemorrhoids	Apple, leaf salad	2,3 (1,6 %)
Colon polyps	Butter cookies (pasta)	1,5 % (1,5 %)
Irritation of the colon	Steamed rice	(0,6 %)

Table 3. In addition, the use of various technological equipment of the grinding department of the mill [12] allows applying different types of deformation of the anatomical components of the grain, such as compression, shear, abrasion or their combination. The specified complex technological methods of processing grain and anatomical components of grains of a mill plant of graded mills in combination with the regimes recommended by scientists of ONAFT and NUFT [6, 12, 14] allow us to confidently assert the possibility of producing grain products with preventive and curative properties at domestic flour milling enterprises. If the actual utilization of the total production capacity of domestic graded flour mills from the production of 7,327 thousand tons of graded flour per year is less than 50%, increasing their workload will not only be possible, but also expedient. The situation is similar with the technological potential of domestic grain mills and feed mills.

In conclusion, we would like to cite the recommendations of the German Nutrition Society for a rational diet. This society substantiated and proved to the general public 10 rules of a *complete diet*. We will list some of them.

First of all, food must be balanced in terms of nutrients and energy capacity. Under these circumstances, it should be borne in mind that the dominant group of food products in terms of energy, ballast substances, proteins and B vitamins are *cereal products* and *potatoes*. Fats and oils are a source of essential fatty acids, *energy* and *fat-soluble* vitamins. *Meat, fish* and *eggs* are a source of proteins, calcium and vitamins. Minerals and ballast sub-



stances, vitamins, carbohydrates and to some extent proteins are contained in *vegetables* and *legumes*. And fruits have the highest content of vitamins, carbohydrates, ballast and mineral substances. Taking into account these features of the nutritional properties of various products, the diet should be as diverse as possible.

It is possible to reduce the content of fats in the blood, excess weight and the burden on the organs of digestion and vital activity by reducing dietary fats in the diet to 80 g per day. Including 40 g of cooking fats for self-use in their native form in the form of various sandwiches and 30-40 g hidden in sausages, pastries, mass, etc.

Since blood pressure is directly related to the consumption of salt, it is necessary to reduce its content in the diet as much as possible, limiting the daily norm to 5-7 g. You can compensate for the salt with a greater consumption of spices and greens.

Minimize consumption of sweets and sugary drinks to reduce blood sugar levels, risk of excess weight, tooth decay and nutrient deficiencies. And to compensate for the body's deficiency in nutrients, ballast and mineral substances, the proportion of whole grain products should be increased. The same applies to the consumption of fruits and vegetables as close as possible to their natural state.

In a complete diet, the amount and frequency of consumption of animal products should be limited. The Society recommends eating small portions of meat and sausages no more than twice a week. No more than three eggs per week. Compensate with dairy products, grain protein, legumes and potatoes.

Drink at least 1.5-2 liters of non-alcoholic liquids every day.

The penultimate rule applies to portioned meals, reducing daily portions by increasing them up to 5 times a day.

The last rule of the Society concerns the methods of cooking with *the help of economic culinary*

*processing* of products in order to preserve as much of the nutrients as possible. Using stewing over low heat with minimal water content, steaming, etc.

In the industrialized countries of Western Europe, for a long time, especially in the last decade, they have been consistently justifying the reformation of the concepts of habitual nutrition, balanced *ecologically safe* and *healthy nutrition*. In the well-founded concept of healthy nutrition, the dominant share of 75% falls precisely on cereals, potatoes, vegetables, fruits and dairy products. And in the list of meat products, it is advisable to increase the share of less energy-consuming and ecologically safer poultry farms. In the same Germany we mentioned above, it is not so far in the future, as by 2030 it is expected to increase the share of grain products with vegetables, fruits and dairy products in the human diet to 75%.

### Conclusions:

1. According to its energy potential, plant products can fully provide the estimated need of mankind in food products, but more than half of them suffer from malnutrition.

2. Compared to vegetable products, animal products are several times more expensive and more ecologically dangerous.

3. By combining the native potential of plant food products and the anatomical components of their grains, it is possible to increase the nutritional value of mixtures, their social significance, and give them therapeutic and preventive properties.

4. The use of modern technological methods of in-depth processing and packaging of specified mixtures of grain components and livestock products can reduce energy and environmental risks to the environment.

5. The potential of domestic flour mills, groats and compound feed enterprises allows to produce grain products with given therapeutic and preventive properties.

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<sup>1</sup>Гапонюк І.І., д-р техн. наук, професор, E-mail: nuft2016@gmail.com

<sup>2</sup>Гапонюк О.І., д-р техн. наук, професор, E-mail: oleg\_odessa@me.com

<sup>2</sup>Гончарук Г.А., Ph.D., Associate professor, E-mail: ganna.goncharuk22@gmail.com

Кафедра технології зберігання і переробки зерна

<sup>1</sup>Національний університет харчових технологій, вул. Володимирська 68, м. Київ-33, 01601, Україна

Кафедра технологічного обладнання зернових виробництв

<sup>2</sup>Одеський національний технологічний університет, вул. Канатна, 112, Одеса, 65039, Україна

## ПРОДУКТИ ПЕРЕРОБКИ ЗЕРНА В РАЦІОНАЛЬНОМУ ХАРЧУВАННІ ЛЮДИНИ

### Анотація

У зв'язку з тим, що продукти рослинного походження широко використовується всіма континентами населення і є обов'язковими в раціональному харчуванні завдяки значного вмісту вітамінів, мінеральних речовин, складних вуглеводів, специфічних речовин, тема їх застосування в раціональному харчуванні потребує ще більш ретельного вивчення. Також вона потребує уваги у зв'язку з тим, що лікарям важливо знати особливості складу і властивостей хліба, хлібобулочних, круп'яних виробів, бобових та інших продуктів переробки зерна, їх загальний та специфічний вплив на організм, доцільне поєднання можливості надання їм певних властивостей з допомогою прийомів дієтичної кулінарії для ефективного використання їх в раціональному, лікувальному, лікувально-профілактичному харчуванні. У статті розкриті поняття, зміст й вимоги до раціонального харчування людини з врахуванням особливостей потреб різних груп споживачів. Відмічено актуальність гармонізації структури харчування за енергетичною та якісною складовою зі змінами екологічного стану довкілля та загостренням морально-етичної чутливості суспільства до тваринницьких джерел харчування. Загострено увагу на зростаючій проблемі екологічної складової промислової індустрії продукції тваринницьких комплексів та пошуку компромісу в збільшенні виробництва продуктів рослинного походження, розширенні асортименту продуктів переробки зерна, вибіркового використання їх анатомічних складових та застосуванні технологій різної глибини їх обробки. Крім екологічної складової переваг продуктів рослинництва над тваринницькою, наведено також економічну та якісну доцільність цього. Зокрема відмічено, що вибірково використанням різних анатомічних складових зернівки можна змінювати енергетичну цінність продуктів харчування в 1,5 – 2,0 рази, кількакратно – вміст в них вітамінів, мікроелементів та біологічно-активних складових, як ензими чи ферменти. До цього ж, застосуванням технологій поглибленої переробки, можна суттєво управляти поживною цінністю зернопродуктів, а саме кількакратним збільшенням вмісту декстринів чи крохмальних зерен, що клейстеризуються. Можливість комбінованого використання різних зернових культур у поєднанні із заданими технологіями їх поглибленої обробки дозволяє надавати продуктам профілактично-лікувальних властивостей. Відмічено позитивну тенденцію інтенсифікації вітчизняної зернової індустрії та зростання її наукового потенціалу. Саме тому, такі рослинні джерела харчування людини, як зернові продукти, у поєднанні з різними технологіями їх оброблення, доцільно використовувати для покриття дефіциту джерел продуктів тваринницького походження, послаблення негативного впливу діяльності тваринницьких господарств на екосистему планети, диференційованого використання в харчуванні споживачів з врахуванням особливостей активності їх життєдіяльності чи вікового стану, а також покращити доступність до продуктів харчування соціально вразливим верствам населення.

**Ключові слова:** зернопродукти, поживна цінність, якість, енергія, екологія, харчування, технології.

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