Buckwheat from the standpoint of traditional medicine and modern scientific ideas: food, energy and therapeutic and prophylactic properties. Allergological risks

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Buckwheat in Traditional Medicine and recent scientific findings: nutritive, energy and preventive properties. Potential allergic risk

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SUMMARY

An information-analytical study of traditional and modern scientifically based approaches to the medical and nutritional use of buckwheat and Tatar buckwheat has been carried out. It is shown that buckwheat is a valuable traditional food product in Russia, and its therapeutic and prophylactic use has a modern scientific justification and a specific list of indications for medical use.

Differences in the chemical composition and biological value of groats that have undergone hydrothermal treatment (which is currently the main product of buckwheat processing entering the trade network) and green buckwheat groats have been revealed. It is shown that, despite the existence of regulatory documents and a number of approved production Rules, today the consumer is not insured against the purchase of buckwheat with reduced nutritional and energy (from the standpoint of traditional medicine) properties. Possible allergological risks of using buckwheat are analyzed.

Key words: buckwheat, buckwheat, green buckwheat, allergological risks, nutrition.

RESUME

We analyzed traditional and modem evidence-based approaches to medical and nutritional use of buckwheat seed and buckwheat tatar. Buckwheat is a valuable traditional nutritional product in Russia, and its prophylactic application is known by a specific list of medical indications. Significant differences in the chemical composition and biological value of widely distributed in the food trade hydrothermal processed cereals and green buckwheat were identified. Today the consumer is not protected from purchasing of reduced in nutritional value and energy buckwheat. We analyzed the potential allergological risk of buckwheat.

keywords:buckwheat, buckwheat groats, green buckwheat, allergological risk, traditional medicine, nutrition, dietetics.

INTRODUCTION

Modern ideas about healthy (optimal) nutrition, from the standpoint of academic medicine, are still based mainly on two basic laws: 1) the correspondence of the energy value of the daily diet to the daily energy consumption of a person, 2) the correspondence of the chemical composition of the daily diet of a person to his physiological needs in food and minor biologically active substances (BAS) [1~4]. At the same time, traditional medical methods of diagnosis, prevention and treatment (Ayurveda, Unani, Siddhe, Traditional Chinese medicine, Korean (Korean) medicine, Tibetan medicine and other traditional medical systems) are also based on their own theoretical concepts, taking into account some properties products that are not taken into account by the so-called Western medicine [3-10].

In almost all traditional medical systems (TMS) of the world, food has historically been considered and is still considered the most important therapeutic and prophylactic factor that determines not only the general level of an individual's health, but also a necessary component of adequate therapy for almost the entire spectrum of diseases [4-7, 10]. Unlike Western medicine, today traditional medicine specialists proceed from the fact that adequate nutrition based on a balanced intake of the main groups of nutrients and energy substances (proteins, fats, carbohydrates), vitamins, macro- and microelements, as well as biologically active substances of other classes (for example, flavonoids and other polyphenols, polysaccharides, unsaturated fatty acids) occupies a leading place among the methods of treatment and prevention of diseases [4, 11].

Food in traditional medicine is the most important therapeutic agent and a source of biologically active substances that have a pronounced physiological effect on the body. At the same time, the effect of food products can be both positive and negative, depending on the specific nosological form of the disease (or symptom complex), the stage of development of the process, the individual characteristics of the organism, the region of residence, seasonality, compatibility with other components of food and drugs, etc. [4, 5].

For example, in the Vedic culinary arts, it is assumed that food

- should not only provide nutritional energy to cells: its second purpose is to promote cleansing mind, harmonization of emotions and consciousness;

- always affects not only the physical condition of a person, but also his mental abilities, moral and spiritual qualities [3, 4, 6, 12].

Traditional Chinese Medicine (TEM) assumes that eating the "wrong food" always leads to disease of the whole organism. "Appropriate" for a particular patient should be the nature of the product, its taste and

origin: vegetable, animal, mineral. Excessive predominance in the diet of products with the same type of thermal effect, for example, the constant consumption of excess raw vegetables and fruits, from the point of view of TEM, inevitably leads to energy imbalance, and, consequently, to illness [4, 9, 10].

A similar theory operates in Tibetan medicine [8]. Harmonious nutrition means adequate nutrition when foods are combined in such a way that the energy balance of the body is restored or maintained. The restoring (Qi) effect of many neutral foods is much faster than long-term attempts to improve health without taking into account these properties of food. The thermal classification of products still existing in Eastern dietology (and medicine in general) is based on their energy effect on the body and is always taken into account when drawing up a plan of therapeutic measures [3, 4, 10]. Of no small importance is the technology for obtaining or preparing food products, including cereals, legumes and cereal products from them [7,10]. In particular, according to ideas, for example, TEM, frozen and then defrosted food,

From ancient times to the present, in traditional dietology, cereals and cereals have been widely used for anti-stress therapy, disorders in the central regulatory triangle (nervous, endocrine, immune systems) and many other areas of phyto- and pharmacotherapy [3, 4].

In Russia, cereal crops have historically been not just the basis of nutrition, but have been sources of therapeutic agents proven over the centuries [13-15]. In our country, the main part of the diet has long been cereals, bread, flour jelly and other products from the grain of cultivated plants [11, 13]. However, in the last thirdXX century such carbohydrate-rich food began to be considered, if not harmful, then definitely not useful, leading to weight gain due to carbohydrates and "ballast" substances. Perhaps this was largely due to the accumulation of knowledge about celiac disease and the not quite adequate perception of the entire class of carbohydrates as a source of accumulation of excess body weight.

According to modern concepts, almost all cereal products, when used correctly, can and should be part of dietary and even medical nutrition [4, 6, 7, 10, 11], and cereal-based dishes are a natural saturation of the body with fiber, free and bound amino acids, protein, vitamins, minerals, which are in them in a biologically available form and often in therapeutic doses [6, 10,11].

One of the most popular and valuable cereal crops in Russia is buckwheat [4, 16]. Buckwheat products have a high nutritional value, good taste and are easily digested in the human body [4, 17-19]. Due to the special properties of buckwheat proteins, the presence of thiamine-binding proteins, flavonoids (including flavones), phytosterols, and other groups of biologically active substances, buckwheat grain is a raw material not only for direct food use, but also for the creation of functional food products [20]. Currently, there is a growing interest in green buckwheat in the absence of widely available scientifically based information about its nutritional and therapeutic and prophylactic value.

The purpose of this work is to identify, analyze and generalize traditional ideas and modern scientifically substantiated data on buckwheat as a medicinal plant and a source of several types of cereals of domestic and foreign production imported to Russia.

The objects of the study were normative documents and bibliographic sources of a high degree. reliability, including monographs, scientific periodicals, reference books, dissertations, abstracts of dissertations and textbooks (in terms of cereal production technology), recommended for use in the prescribed manner. Internet resources with links to bibliographic sources of a high degree of reliability were also taken into account.

When assessing allergological risks, we took as a basis information from the electronic database of the official website of the Subcommittee on Allergen Nomenclature of the International Union of Immunological Societies of WHO (WHO / IUIS Subcommittee on Allergen Nomenclature) [22], and also used the official materials of EAACI (European Academy of Allergy and Clinical Immunology) [22-25].

When performing the work, the following research methods were used: information-analytical, historical, content analysis, systematization.

1. Characteristics of the object of study

1.1. producing plants

The genus Buckwheat includes two main botanical species - the ordinary buckwheat, or sowing (subdivided into winged and wingless) and the Tatar r. (smaller and thick-skinned).

Common buckwheat (sowing) -Fagopyrum esculentum Moench (Fagopyrum sagittatum Gilib.); synonyms: edible buckwheat, common buckwheat, buckwheat, buckwheat, buckwheat, Greek wheat - a species of herbaceous plants of the genus Buckwheat (Fagopyrum), fam. Buckwheat (Polygonaceae) [4, 16].

An annual herbaceous plant with a straight, branched stem 15-70 cm high. The stem is naked, rarely covered with small papillae at the top, reddish, ribbed. Leaves alternate, cordate-triangular or cordate-sagittate, pointed, up to 5 cm long; the lower ones are long-petiolate, the upper ones are almost sessile. It blooms in July, attracting many bees (buckwheat honey is dark, from the standpoint of oriental medicine, one of the hottest). Small pink bisexual flowers on pedicels are collected in corymbose inflorescences, up to 15 cm long, located on the tops of the shoots. One of the best honey plants (60-100 kg of honey can be obtained from 1 ha of sowing) [4, 26].

The fruits are sharp-triangular brown or dark gray nuts covered with membranous shells. After

seeds are small triangular (trihedral) light green in color, 5~7 mm long and 3-6 mm thick, ripen in September-October. Fruiting in August (late culture): in the Russian Federation, harvesting usually begins in late August - early September. The fruits ripen very unevenly: the lower (ripened) ones easily break off and crumble, while the top is covered with flowers.

The modern technology of processing buckwheat grain into groats includes the following processes: purification from impurities, fractionation, steaming, peeling, separating groats. In accordance with GOST 5550-74 [27], the main types of products obtained at buckwheat processing plants are unground buckwheat and prodel (including quick-cooking ones) [28]. However, today buckwheat groats (unground kernels) are made from buckwheat - whole grains (buckwheat, buckwheat), prodel (crushed grain with a disturbed structure), Smolensk groats (heavily crushed grains), "green buckwheat" (Table 1), buckwheat flour and flakes. The last two products are secondary to the traditional core and prodela: for the production of buckwheat flour, the finished cereal is simply crushed, and for the production of flakes, it is subjected to additional hydrothermal treatment, flattened and dried. Similarly to flakes, cereals are also obtained that do not require cooking, for which the flattening operation is excluded from the technological process [28].

Table 1

Buckwheat as a source of domestic cereal products

Name producing plants	Grain (synonyms)	generated cereal products (kind of cereal)	Characteristic
Buckwheat sowing - Fagopyrum esculentum Moench., Sem. Buckwheat - Polygonaceae	Buckwheat [29, 30] Buckwheat grain food [31] Synonym: Buckwheat	Buckwheat groats [8, 18, 29, 31] rennaya) [32]	Produced from parboiled grain (grades: superior, first, second, third) [32] Whole grains (buckwheat, buckwheat) [18] Color - brown in different shades [32]
		Green buckwheat [33~35], or kernel (unsteamed) [32]	Produced from non-steamed grain (grades: highest, first, second, third) [32] Whole grain that has not undergone hydrothermal treatment [35-37] Color - cream with a yellowish or greenish tint [32]
		Buckwheat groats [8, 29, 31] (unsteamed) [32]	Produced from unsteamed grain (not divided into varieties) [32] Crushed grain with a broken structure [18], or buckwheat kernels split into pieces [32] Color - cream with a yellowish or greenish tint [32]
		Buckwheat groats [eight, 29, 31] (steamed) [32]	Produced from steamed grain (not divided into varieties) [32] Crushed grain with broken structure [18] Splitted buckwheat kernels [32] Color - brown in different shades [32]
		Smolensk groats [18]	Heavily ground grains [18]

Straw and waste left during the processing of grain to produce cereals is considered a valuable feed for livestock. Chaff and straw are similar in nutritional value to other spring grains, but they are fed in moderation and only mixed with other feeds. Otherwise, white-colored animals develop the so-called "buckwheat disease" - photodermatitis (edema, skin itching, loss of appetite; in severe cases, loss of consciousness) [4]. Eating large quantities of fresh and dried flowers, hay, seeds, and even straw has a rather strange effect on animals, reminiscent of the effect that cannabis has on humans. At the same time, the seeds are the least dangerous, and when cooked, they generally lose these properties. The flowering tops are the most dangerous. The active compound causing these phenomena has not yet been unambiguously identified [4, 11, 38,

Buckwheat Tatar -Fagopyrum tataricum (L.) Gaertn. (syn.: Tatar wild grouse, kirlyk). The species grows wild in Siberia, occurs in two forms: common and rye, or rye-like (Fagopyrum tataricum (L.) Gaertn. var. stenocarpa). Both forms are insensitive to frost, undemanding to soil cultivation and reach a height of 1.0-1.5 m. It is practically not used for food purposes, although the fruits are edible; the herb may be suitable for getting rutin. The grains are small thick-skinned, therefore they are sown to obtain valuable green fodder with a high content of polyphenols. In private gardening and country gardening, with a lack of organic fertilizers, it is used as green manure: the biomass in the flowering phase is crushed and incorporated into the soil as a fertilizer [4]. Currently, buckwheat tea Ku Qiao Cha "Black Pearl" (China,

1.2. Origin and spread of culture

Buckwheat is not found in the wild. Has a long history of cultivation; spread from

the Himalayas and South Asia. Until now, Southwestern China has been a center for the cultivation of various types of buckwheat, including semi-wild and wild ones [41]. Some researchers believe that common buckwheat originated from Tatar buckwheat, a widespread weed. The homeland of Tatar buckwheat is considered to be North India, where it is called "black rice". Wild forms of the plant have been preserved on the western spurs of the Himalayas, where the plant was first introduced into cultivation more than 5 thousand years ago [4, 16]. In the XV century BC. cultivated buckwheat was brought to China, Korea and Japan, then to the countries of Central Asia, the Middle East, the Caucasus, and later to Europe. According to some reports, this happened during the Tatar-Mongol invasion, because it is also called the Tatar plant, or Tatar. In France, Belgium, In Spain and Portugal, it was called "Arab grain", in Italy and Greece itself - Turkish, in Germany - pagan grain. The Slavs began to call buckwheat groats, since it was brought from Byzantium in the 7th century [13]. According to other sources, for many years it was cultivated mainly by Greek monks at monasteries, hence the name [42].

Currently, buckwheat is grown in the northern hemisphere of the Old and New Worlds [4, 16]. In a number of European countries, buckwheat is called beech wheat (from German Buchweizen) due to the resemblance of seeds to beech nuts. The Latin name of the genus Fagopyrum is translated as beech-like nutlet [16]. The crop is low-yielding: low and unstable yields are explained, on the one hand, by the significant influence of weather conditions, and, on the other hand, by insufficient attention to modern technologies of agrotechnical processing [17]. In terms of buckwheat production in 2014, Russia ranks first in the world, China - second, Ukraine - third (Table 2).

table 2

Buckwheat production volumes in 2014 in the top 10 producing countries, according to FAO (Food and Agriculture Organization [43]

	The country	Square crops (ha)	Volume production (t)
one	RF	712.047	700,000
2	PRC	708,000	661.764
3	Ukraine	136.700	167.440
4	USA	78,000	83,000
5	Kazakhstan	64,600	46,500
6	Poland	62.710	83.499
7	Japan	59,900	31,100
eight	Brazil	49,000	64,000
9	Lithuania	37,400	35,600
10	France	30,100	111.300

1.3. food traditions

Buckwheat appeared in Russia in the 15th century and has since become a national Russian dish [13]. Suvorov called it "Bogatyr porridge" [44]. “During the sowing of buckwheat on June 13, the day of buckwheat is celebrated, buckwheat porridge is necessarily cooked, and everyone should eat it to the full so that there is a good harvest of buckwheat.” In accordance with the Orthodox Christian tradition, June 26 is considered the Day of St. Akilina (Akulina), and among the people - the Day of Porridge. On this day, Russian peasants prayed to St. Akulina for the harvest of buckwheat, and they always cooked porridge on this day from buckwheat groats of past years [13]. Today, cereals are eaten in the form of cereals, side dishes, casseroles; flour is used in the baking and confectionery industry, in home cooking - for baking fritters, pancakes, cakes, cookies [4]. Literally 20~25 years ago, muesli (a mixture of processed cereals with the addition of fruits and nuts that do not require a long cooking time) and so-called "quick cereals" began to be widely used as one of the components of "healthy diets". Neither one nor the other can be compared with classic homemade cereals and other cereal dishes either in terms of nutritional value or therapeutic and prophylactic effect [11].

In the domestic tradition, vegetable oils (sunflower, hemp, linseed, walnut, poppy) were usually used with cereals, spices - most often onion and garlic, and in significant quantities, as well as parsley, anise, coriander, black pepper and cloves. Some cereal dishes were prepared sweet by adding raisins, dried apples and berries [4, 11, 13]. The methods of preparing cereal dishes, including buckwheat, in traditional Russian cuisine are quite diverse: the modes of heat treatment of cereals change, milk, water, fruit or vegetable juices and decoctions can serve as the basis for cereals. The use of grain in whole, crushed, ground form, various "fillers", additives allow not only to diversify the taste of dishes, but also to vary their therapeutic effect [4, 11, 13]. A similar therapeutic effect of cereals is known in TEM [9], Ayurveda [6] and other TMS.

Despite the fact that buckwheat invariably occupies an honorable place in the traditional diet of different medical cultures of the world, it is not recommended for everyone. For example, in Ayurveda, buckwheat without fillers can only be consumed by representatives of the Kapha constitutional type, it is not suitable for the other two constitutional types in its pure form (Table 3). Since it increases the formation of mucus, gases, black bile, and overexcites the body, it is not recommended for children to give it too often [44].

Table 3

Recommendations for the use of buckwheat in the Ayurvedic tradition, depending on constitutional type of the patient [6]

cotton wool		PITTA		KAPHA	
Not	Yes	Not	Yes	Not	Yes
Buckwheat		Buckwheat			Buckwheat

In terms of buckwheat production, China ranks second. Tartar buckwheat has been cultivated there since the 2nd century BC. and is one of the earliest food crops in this country. Translated from one of the dialects, it is associated with the name of the mother and is used in the traditional rites of the Yi holiday, as well as religious festivals in Nepal. Lamaist monks also use it for religious purposes [41]. According to Chinese legend, Emperor Taizong of Song fought off an enemy army and was surrounded. Provisions ran out, the soldiers were exhausted, wounded and discouraged. Local residents began to feed them with buckwheat, thanks to which, in a short time, the army restored its combat capability and defeated the enemy. For miraculous salvation, buckwheat, which gives strength and health, began to be called "The Grain that saves the state,

The second legend refers to the period of the Jin Dynasty (265-420 AD), when the ruler of Wang had 9 sons, each of whom he gave to rule over the kingdom. When the plague broke out, no means helped either the poor or the rich. The eighth son of the sovereign, Prince Shu sincerely suffered from the fact that he could not help his people in any way, and turned to heaven. Then the ancient emperor and author of the first Pharmacopoeia on earth, Shen Nong, wished to learn more about this disease and descended from heaven to the kingdom of Prince Shu. Seeing how the prince worries about his people, the great Shen Nong decided to petition the Heavenly Sovereign for him, but it was difficult to get to the lord because of the large number of applicants, and the disease continued to take people away. Then Shen Nong decided to manage with his own means and scattered buckwheat seeds throughout the kingdom of Prince Shu, which sprouted and brought forth a harvest. As soon as people began to eat it, in the kingdom of the eighth son of the ruler of Van, the disease receded [40].

Buckwheat production in the PRC is constantly increasing, and in the 21st century, its production and production exceeded all other grain crops grown for cereals. Some countries, such as Japan, import buckwheat from China. Buckwheat is used for the production of baby food, bread, pies, porridge, sausages. It is a local food in Nepal. Both in China and Nepal it is also used for the production of local varieties of wine and whiskey [41]. In the PRC, local factories in some provinces produce wine and vinegar from buckwheat, which are used locally, but sometimes also supplied to city supermarkets [41].

Tartar buckwheat grains are used to make various types of tea, which is used to lower blood pressure, lipid levels and blood glucose, especially when mixed with Lycium spp. [41]. The technology for making buckwheat tea, called “Black Pearl” by the Chinese, has been used in China since at least the time of the Tang Empire (Li Yuan - 7th century AD). According to the Chinese Herbal Treatise, "buckwheat tea is bitter in taste, neutralizes cold, adds qi energy, balances the mind, sharpens hearing and vision, and promotes digestion." Now black buckwheat is grown in the Chinese provinces of Sichuan, Yunnan, GuiZhou and Shanxi [40]. Some domestic tea companies indicate Tatar buckwheat as a producing plant (in Russian), but in Latin - Fagopyrum esculentum (sowing). It is also reported here that this is “a special variety of black buckwheat - it is about 2 times smaller than buckwheat”; there is also green buckwheat tea [40].

2. Chemical composition of buckwheat seeds (buckwheat)

General information about the chemical composition of buckwheat (according to literature data) is given in accordance with the modern classification of BAS groups.

Carbohydrates. The carbohydrates that make up buckwheat are mostly complex, they break down slowly, and, due to their resistance to amylase, buckwheat has a low glycemic index [46]. They are absorbed by the body for a long time, therefore, after its use, a feeling of satiety usually occurs, which lasts for a relatively long time [18]. The content of carbohydrates in buckwheat, as in other cereals (barley, millet), is, according to various sources, from 60% to 68.8% [18], of which starch is 55.4% [18] (according to other sources, 67~80% [4]), dietary fiber
- 11.3%, simple carbohydrates (sugars) - 2.1% (Table 4).

Table 4

The content of carbohydrates and fats in buckwheat [18]

Nutrients	Norm consumption, g/day	Content in 100 g product, %	Satisfaction daily needs, %
Carbohydrates, g., total	400-500	66.7	14.8
Including: starch	400-500	58.2	13.7
Alimentary fiber	thirty	8.0	26.7
Sahara	-	2.1	-
Fat, g, total	80-100	3.3	3.7
Including: - vegetable	30-40	3.3	9.4
- unsaturated fatty acids	eleven	2.28	20.7
- saturated fatty acids	25-30	0.59	2.1

Starch. Buckwheat starch is considered one of the best among the starches of cereals [eighteen]. According to foreign data, the starch content in cereals is 71-78% [47-49], according to domestic data - 67~80% [4] or even up to 87% [26]; in various types of flour - 70-91% [47-49]. Starch is composed of 25% amylose and 75% amylopectin. Depending on the hydrothermal (steam-heat) treatment, buckwheat contains from 7 to 37% resistant starch.

Buckwheat starch is a valuable nutrient; it is insoluble in water, but in the stomach under the action of enzymes it is easily hydrolyzed, which determines its good digestibility. It has a high water absorption capacity and swelling capacity, which ensures a significant increase in its mass and volume when cooking cereals. It also differs in that the colloidal system formed from it during cooking is stable and provides a good soft porridge that retains its consistency for a long time [18].

Alimentary fiber. Buckwheat contains11.3% of dietary fiber [45], which allows it to satisfy the daily human need by 37.7% (more than a third). According to the content of dietary fiber, buckwheat occupies the first place among all types of cereals [18].

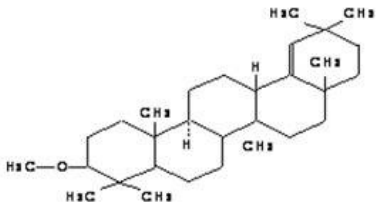
Sahara. Simple carbohydrates of buckwheat are represented mainly by sucrose [eighteen].

Fats. Buckwheat contains2-3% fats [4], according to other sources - 3.3% (Table 4), in which 69% are mono- and polyunsaturated fatty acids: linoleic, linolenic, oleic [18]; a total of 9 aliphatic acids were identified [50]. The content of the fat fraction is higher than in rice and wheat [50].

The fat of buckwheat, unlike, for example, millet [4], is stable during storage, which allows it to maintain its qualities for 20 months - for ground kernels and 18 months - for prodel in the conditions of the northern and middle climatic zones of Russia, as well as in for 15 and 14 months, respectively, in the conditions of the southern regions [18]. Since buckwheat does not go rancid or moldy at high humidity during long-term storage [35, 4], its fats do not oxidize [51], and its nutritional and taste qualities do not decrease [4, 51], it belongs to strategic products that are included in military reserves [4]. The stability of fat is ensured by its high content of vitamin E, which protects unsaturated fatty acids from rapid oxidation and rancidity [18]. According to other data, the protection of buckwheat grains from souring to a greater extent than all other types of cereals,

A feature of the fat-soluble fraction of buckwheat is the presence in it of lecithin and miliacin (up to 4.5%), isolated for the first time from millet oil in 1991 [52].

Miliacin is a white substance with a melting point of 285-286°C. It is optically active, insoluble in water, slightly soluble in ethyl alcohol, diethyl ether, acetone, freely soluble in chloroform. Based on the mass, NMR, and IR spectra, chromatographic homogeneity, and qualitative composition, the substance was assigned to the group of pentacyclic triterpenes with the 3-p-methoxy-A18-oleanene structure [52]. The chemical structure of the pentacyclic triterpenoid miliacin is shown in fig. one.



Rice. 1. Miliacin formula

Proteins and free amino acids. Among cereal crops, buckwheat occupies a somewhat isolated place: proteins have a unique amino acid composition [53] and consist of well-balanced amino acids [20; 46]. V

on average, cereals contain from 8 to 20% (in the southern regions) of easily digestible protein substances with a high content of amino acids such as lysine, arginine, tryptophan [4]; according to other data - 6-12% of proteins [26]. In terms of the content of lysine and methionine, buckwheat proteins surpass all cereal crops [11]: there is much more lysine than in wheat (Table 6), and in terms of the amount of arginine, it exceeds rice groats [51].

According to foreign data, the content of crude protein is 18%. Buckwheat protein has a biological value of over 90% [54], which is explained by the high concentration of all essential amino acids [55], especially lysine, threonine, tryptophan, and sulfur-containing amino acids [56, 57]. In terms of the number of valuable amino acids, proteins are close to products of animal origin [4, 38, 35] (Table 6).

The protein fraction of buckwheat is characterized by a high content (more than 50%) of water-soluble (albumins) and salt-soluble (globulins) fractions. These fractions are considered the most valuable, due to the fact that they are more susceptible to the action of the enzymes of the stomach and intestines, therefore, they are more easily and completely absorbed by the human body [58, 59, 35]. According to other data, easily soluble globulins and glutamine predominate, which is why buckwheat protein is better absorbed and more useful than cereal proteins [51]. In table. Figure 6 shows the amino acid composition and biological value of buckwheat protein in comparison with cereals and chicken egg protein [35]. According to foreign researchers (Japan, China, Czech Republic, Poland, Romania [56, 57], the qualitative composition and quantitative content of proteins in buckwheat and flour depend on the buckwheat variety [60, 61],

The usefulness of buckwheat protein is confirmed, including by its amino acid composition (Table 5): 32.34% of essential amino acids, with a high content of leucine, isoleucine, valine, threonine, lysine, phenylalanine. In buckwheat, as in oatmeal, there is little tryptophan (Table 5), however, at a low recommended rate of its consumption, 100 g of buckwheat provides 18% of the daily need for tryptophan [18]. Satisfaction of the daily human need for essential amino acids with buckwheat is 10~25%. Of the essential amino acids, its protein is rich in arginine, alanine, serine, glycine, aspartic acid, and histidine (Table 5). The ratio of amino acids in relation to tryptophan indicates their good balance: tryptophan

- one; leucine - 3.8; iso leucine - 2.9; valine - 3.3; threonine - 2.8; lysine - 3.5; phenylalanine - 3; histidine - 1.7 and only methionine - 1.4 [18].

Table 5

The content of proteins and amino acids in buckwheat [18]

Nutrients	Norm consumption, g/day	Content in 100 g of product, %	Satisfaction daily needs, %
Proteins, g, total	80-100	12.8	14.2
including albumin and globulins	-	6.5	-
Amino acids, g, total	67.5-82	12.06	16.1
Essential amino acids	20-31	3.9	15.3
Including: tryptophan	one	0.18	18.0
leucine	4-6	0.68	13.6
isoleucine	3-4	0.52	14.9
threonine	2-3	0.50	20.0
valine	3-4	0.59	16.9
lysine	3-5	0.63	15.8
methionine	2-4	0.26	8.7
phenylalanine	2-4	0.54	18.0
Non-essential amino acids	47.5-51	8.16	16.6
Including: histidine	1.5-2.0	0.3	17.1
arginine	5-6	1.12	20.4
cystine	2-3	0.33	13.2
tyrosine	3-4	0.43	12.3
alanine	3.0	0.58	19.3
series	3.0	0.68	22.7
glutamic acid	16.0	2.26	14.1
aspartic acid	6.0	1.21	20.2
glycine	3.0	0.75	25.0
proline	5.0	0.5	10.0

Table 6

Amino acid composition and biological value of buckwheat and cereals compared to protein chicken egg [35]

Name amino acids	Legumes and cereals				Protein chicken eggs
	Buckwheat	Barley	Wheat	Corn	
Lysine	5.1	3.7	2.5	2.8	6.0
Methionine	1.9	1.8	1.8	2.4	3.8
Cysteine	2.2	2.3	1.8	2.2	2.4
Threonine	3.5	3.6	2.8	3.9	4.3
Valine	4.7	5.3	4.5	5.0	7.2
Isoleucine	3.5	3.7	3.4	3.8	5.9
Leucine	6.1	7D	6.8	10.5	8.4
Phenylalanine	4.2	4.9	4.4	4.5	6.1
Histidine	2.2	2.2	2.3	2.4	2.2
tryptophan	1.6	1D	1.0	0.6	1.5
Biological value (%)	93.1	76.3	62.5	64.3	one hundred

organic acids. Maleic, linolenic, oxalic, apple, lemon [4, 26, 51].

Polyphenols. The content of routine in buckwheat is10-200 ppm, tannins 0.1-2.0% [62]. Catechol-7-O-glucoside was found [63].

Vitamins and minerals. Vitamins are among the most important substances in foods. TO vitamins include a variety of compounds - nitrogenous and nitrogen-free, including alcohols, acids, amines. All of them are needed in the diet, but in very small doses, unlike other nutrients [64]. Ascorbic acid is absent in grain products [64]. The vitamin-mineral complex of buckwheat is considered valuable [18] (Tables 7, 10, 11). High in B vitaminsoneV2, RR, Vb, pantothenic acid, folacin, choline, vitamin E; biotin, β-carotene, rutin are present [4, 18, 26]; inositol derivatives found: Fagopyritol A1 and Fagopyritol B1 (mono-galactosyl D-chiro-inositol isomers), Fagopyritol A2, Fagopyritol B2 (digalactosyl D-chiro-inositol isomers) and Fagopyritol B3 (tri-galactosyl D-chiro-inositol isomers) [65].

Buckwheat minerals (Tables 7, 10, 11), like vitamins, play an important role in metabolism, since they are in the form of well-assimilated salts of various organic and mineral acids, and are also part of macromolecular organic compounds in the form of chemical elements. Calcium plays a leading role in intracellular processes, protects membranes from destruction, thereby preventing tissue aging and other functional disorders. Phosphorus in combination with calcium is involved in the formation of bone tissue; necessary for the synthesis of complex proteins, phosphatides, as well as for the formation of complex organic compounds that are accumulators of energy released during the biochemical transformations of fat, sugars and other nutrients. Grain products are richest in them [64].

Table 7

The content of vitamins and minerals in buckwheat [18]

Nutrients	Norm consumption, g/day	Content in 100 g product, %	Satisfaction daily needs, %
Vitamins, mg:			
IN 1	1.5-2	0.53	30.3
IN 2	2-2.5	0.24	10.7
RR	15-20	4.3	24.6
P-carotene	3-5	0.01	0.25
wb	2-3	0.4	sixteen
Pantothenic acid	5-10	1.5	twenty
Folacin	0.2-0.3	0.032	12.8
Choline	250-600	one hundred	23.5
E	twenty	6.65	33.2
Biotin	0.15-0.3	0.006	2.7
Minerals, mg:			
Calcium	1000	70	7
Phosphorus	1000	298	29.8
Magnesium	400	200	50
Potassium	3500	380	10.9
Silicon	thirty	81	270
Iron	14	eight	57.1
Zinc	10-15	2D	16.8
Manganese	5-10	1.6	21.3
Copper	2	0.64	32
Sulfur	1000	48	4.8
Aluminum	one hundred	-	-

Of the minerals in buckwheat grain, a significant amount of calcium, phosphorus, magnesium, potassium, zinc, manganese, copper, silicon [18, 26, 4], iodine [4, 26], contains a lot of iron [4]; sulfur [18], fluorine, molybdenum, cobalt [4] are present. According to foreign data, buckwheat is rich in iron (60-100 ppm), zinc (20~30 ppm) and selenium (20-50 ppb) [56, 57, 66].

According to the modern classification of cereals and legumes, depending on the content of macro- and microelements adopted in food chemistry [67], buckwheat and buckwheat groats are classified as products with a fairly high content of potassium (385–200 mg/100 g), iron (11770– 6500mcg/100g), magnesium (320-150mg/100g), manganese (1900-1200mcg/100g), copper (900-400mcg/ 100g), zinc (2900-1000mcg/100g) , phosphorus (366-190 mg/100 g), boron (840-490 mcg/100 g), titanium (180-90 mcg/100 g), vanadium (200-140 mcg/100 g), nickel (85-50 mcg/100 g), strontium (300 mcg/100 g).

Comparative analysis of grain, flour and bran (for the content of Se, Cr, Rb, Zn, Fe, Co, Sb, Ba, Ni, Ag, Hg and Sn) of different types of buckwheat flour made it possible to establish that most of the trace elements are concentrated in bran . Significant differences in the content of iron, antimony and chromium between flour (transition coefficient - 55%) and bran were established. In the flour of fine grinding (transition coefficient - 42%), a lower content of microelements was revealed than in ordinary flour. The expediency of using buckwheat bran as a dietary source of such important elements as Zn and Se has been reliably proven [56, 57]. Taking into account the biological role of selenium, work on the field enrichment of buckwheat with this element has intensified in order to obtain a potential source of dietary selenium for animals and humans [69].

aromatic compounds. Salicylaldehyde (2-hydroxybenzaldehyde) was identified as a characteristic component of buckwheat, containing an aromatic ring in its structure [69]. Among other aromatic compounds, the presence of 2,5-dimethyl-4-hydroxy-3 (2H)-furanone, (E, E) -2,4-decadienal, phenylacetaldehyde, 2-methoxy-4-vinylphenol, (E) -2 -nonenal, decanal and hexanal. The aroma of these substances in an isolated state does not resemble the smell of buckwheat [70].

Official data on the chemical composition and nutritional value of domestic buckwheat are presented in tables [29-31, 71].

Due to the presence of Chinese-made buckwheat on the Russian food market, we considered it necessary to provide information on its chemical composition. According to [50], Chinese buckwheat contains 10.9–15.5% protein, 2.1–2.8% fat, 63.0–71.35% starch, and 1.0–1.6% fiber. Like domestic cereals, it is a very valuable crop in terms of the content of essential amino acids (which distinguishes it from all other cereals), such as lysine (5~7%), unsaturated fatty acids, minerals, vitamins (B$_{one}$, V$_2$, PP, P (rutin), folic acid (higher than in other cereals).

3. Buckwheat

3.1. Production of cereals and flour

Buckwheat is produced from cultivated buckwheat grains (Table 1). Buckwheat grain processing technology, like other cereals, is regulated by regulatory documents and rules [72]. However, at each buckwheat plant there are certain deviations from the recommended technology. Therefore, the number and range of products produced by different manufacturers can vary significantly. Accordingly, the chemical composition of these products also differs [20, 37].

The standard technological process for the production of buckwheat includes the following steps: purification from impurities; hydrothermal treatment (HTP) of grain, which consists in steaming and subsequent drying it; sorting of steamed grain into 6 fractions by size; fractional peeling of grain in order to remove the flower shell from it and obtain a kernel; sieve, air and magnetic control of finished cereals [36, 37, 73]. TRP of grain is a very important stage in the technology of processing buckwheat into groats. For such cereal crops as buckwheat, oats and peas, it is reduced to the stages of steaming, drying and cooling [36, 73].

As a rule, grain is treated with steam at a pressure of 0.25~0.3 MPa, and drying is done with air heated to 150-180°C [20, 37]. Steaming moisturizes and warms the grain, plasticizes the core, which becomes less brittle, less crushed during peeling and grinding. Plastification of the core also occurs as a result of some chemical transformations: gelatinization of some part of the starch, the formation of a small amount of dextrins with adhesive properties, etc. in the process of steaming and drying, deformation changes in the constituent parts of the grain lead to peeling of the shells. The cooling following drying further reduces grain moisture (cold shells are more fragile) [36, 37, 73]. The TRP of grain significantly increases the yield of the kernel as a result of a decrease in the number of cuts, as well as the yield of cereals of the first grade: the total yield of cereals increases by 1%, the yield of the kernel of the 1st grade - from 52 to 59%, the yield of the cut decreases from 10 to 5% [36].

The improvement in the technological properties of cereal crops during GTO is largely due to changes in the chemical composition of the grain (and especially the kernel) under the influence of heat and moisture, but at the same time, consumer properties of cereals (culinary advantages and storage stability) also improve [37]. Groats from steamed grains acquire a brown color, pleasant taste and aroma, cook faster, have a longer shelf life due to better sanitary and hygienic indicators. The reduced time of cooking cereals from steamed grains made it possible to give it the names: “fast-cooking core” and “quick-cooking prodel” [20, 53].

It is believed that the nutritional value of unground and prodel cereals is almost the same [30, 74–76] and

it is usually characterized by the content of protein and amino acids, carbohydrates and fats, vitamins and minerals (Tables 4, 5, 7). The content of nutrients is usually calculated against the background of daily human consumption norms developed by the Research Institute of Nutrition of the Russian Academy of Medical Sciences [123]. At the same time, there is evidence that in the case of technological processing of buckwheat without the use of steaming (GTO with moistening, softening, and drying [37]), with a constant total amount of protein, the amount of starch decreases (Table 8). And the fractional composition of the protein under the influence of processing undergoes significant changes: the relative content of the isolated protein fractions after the TRP decreases. The most sensitive to processing are albumins and globulins (their relative content decreases by 2.9 and 1.7 times, respectively), the amount of prolamins and glutelins decreases to a lesser extent. The decrease in the content of all four protein fractions is associated with their partial denaturation and transition to an insoluble residue [37].

From Table. 8 it can be seen that the starch content decreases depending on the severity of the TRP regime: in regime (3) the content is reduced by 2.8%, in regime (2) - by 1.3%, compared with (1). This is explained by its partial non-enzymatic hydrolysis to sugars, some of which are involved in various reactions, for example, melanoidin formation [37, 77] or the formation of complex complex compounds of starch with lipids and other grain components [37, 78]. Based on the above data, the consumer's interest in "green buckwheat" can be considered quite reasonable.

Table 8

Changes in the chemical composition of cereals with various methods of hydrothermal treatment (HTP) [37]

Way processing grain	Content, % per dry weight		Quantity of protein fractions, % to the sum				
	starch	Squirrel (N-6.00)	Albumins	Globulins	Prolamins	Glutelins	Undissolved
1. Green grits (without TRP)	67.7	13.4	22.7	25.6	11.5	17.1	23.1
2. TRP with moisture, smoothing and drying	66.4	13.3	14.0	19.3	9.7	16.1	40.9
3. TRP with steaming and drying (according to [Rules, 199])	64.9	13.3	7.9	14.9	7.8	13.6	55.8

In addition to cereals, flour is produced from buckwheat. In the baking industry, it is used only as an additive to wheat or rye flour. The pasta industry currently produces gluten-free pasta. The share of its use in Russia is low - no more than 0.2% of the total amount of wheat flour [20]. Due to the enzymatic hydrolysis of buckwheat grain lipids, the products of its processing can have high acidity and acid number of fat, this is most pronounced for products with a developed surface - flour and husks [20]. In the EU countries, the USA and Japan, 2 types of grinding are traditionally used for the production of buckwheat grain flour. When grinding the first type, the shells are ground together with the core and dark flour is obtained,

According to domestic experts in the baking industry, buckwheat flour can become a source of enrichment and increase the nutritional value of bread. The introduction of buckwheat flour enriches wheat flour with a more complete protein, vitamins and minerals, which improves the taste and aroma of bread, slows down staleness and increases its nutritional value [79]. To date, recipes have been developed for the production of bread from premium wheat flour with the addition of buckwheat flour [80]. It has been established that the use of buckwheat in an amount of up to 10% instead of part of the flour in the production of bread is possible and expedient. Bread with buckwheat is characterized by good physicochemical and organoleptic characteristics, as well as increased nutritional value [81]. Studies conducted at Samara State Technical University on the effect of buckwheat flour on the quality of bread from wheat flour of the 1st grade [82] make it possible to bake high quality bakery products. The possibility of using buckwheat and prodel for the production of bakery products is also being studied [83, 84].

3.2 Buckwheat: advantages and dangers of new technologies

In connection with the development of new food technologies, today the country and the specific technology for the production of food products, including buckwheat, are of paramount importance for nutritionists and their patients. As one of the negative examples of improving the so-called resource-saving technologies for the production of buckwheat, we cite Ukraine, where the technology of grain preparation by hot conditioning was used until recently for the production of buckwheat [17].

Having stated that the classic GTO using steaming followed by drying and cooling significantly reduces the nutritional value of cereals and requires high energy costs for grain preparation, in the second decade of the 21st century. Ukraine has proposed "new technologies for obtaining buckwheat" [17], which, from the standpoint of traditional medicine

[10], actually change the bioavailability and energy structure of the grain. The introduction of this technology, which provides for microwave processing of grain in order to save money, actually deprives the consumer of the biological value of cereals in terms of its energy value (the ability to replenish qi energy) and bioavailability from the standpoint of traditional medicine [10]. Interestingly, if we approach this issue from the standpoint of modern science, then, according to Yusupova et al. (2014), in cereal samples treated with microwave energy, the protein content decreases [64].

Taking into account the dietary postulates of TCM in terms of "live" and "lifeless" food (which gives the body nothing but calories, in particular, it does not give vital energy Qi) [7, 10], the proposed [17] so-called resource-saving technological processing of buckwheat raises serious doubts about the possibility of its use for the improvement of the population. The work carried out at the Odessa National Academy of Food Technologies (on the topic “New technologies for the production of grain products”) justifies the introduction of grain processing (at the preparatory stage) with an ultra-high frequency field to improve quality and reduce operating costs for the production of buckwheat [17]. “The most efficient and least energy-consuming in the production of buckwheat is the technology of grain processing using water-heat treatment with a microwave field (at a microwave field strength of 225–300 V / cm)”, which “allows to reduce energy costs in the process of hydrothermal processing of buckwheat grain by 35–40% and increase the yield of whole buckwheat by 2–5% compared to the classical technology.” At the same time, after the TRP by a microwave field with a strength of 225 V / cm, the cooking time is reduced by 35-40%, at a voltage of 300 V / cm - by 45-55%, which reduces the preparation of buckwheat without cooking to 4-5 minutes. As follows from [17], the main motivation of developers is economic - the planned increase in profits is 826 thousand UAH. per year, and the payback time of balance costs for implementation is 1,

Since the introduction of the described technology at Ukrainian cereal enterprises is recommended today [17], after a while, consumers of Ukrainian cereals may face the problem of its biological value. Thus, today, when looking for suppliers of raw materials, it is necessary to take into account, among other things, the technology of primary processing of cereals.

Unfortunately, similar technologies are beginning to be promoted in our country [64] without taking into account the experience of traditional medicine, in connection with which interest in the so-called “green buckwheat” is especially growing.

4. Pharmacotherapeutic properties of buckwheat and use in dietetics

For food and medicinal purposes, dried fruits are used in buckwheat (raw materials are unofficial in the Russian Federation); for medicinal purposes - fresh and dried flowering shoots, flowers and leaves (as a source of the flavonoid glycoside rutin). Rutin is approved for medical use on the territory of the Russian Federation as an angioprotective agent; is part of ascorutin, vikalin and other drugs. It is obtained from buckwheat flowers and leaves [4, 19, 85].

4.1. Experience of traditional (folk) medicine

An infusion of flowers, leaves, and herbs is used in folk medicine as an expectorant [4, 19], tea (infusion) from flowers and leaves is used for atherosclerosis, especially against the background of high blood pressure [26], and in oncology, for leukemia [86]. In Russia, buckwheat was considered a good remedy for heartburn - raw groats were chewed on a pinch; with lumbar pain, they steamed her in the oven and covered her back with the resulting slurry; “from the face” it was sprinkled on a hot splinter so that the burnt flour fell on the sore spot [15]. In the Voronezh province, a patient with jaundice was rubbed with liquid buckwheat porridge, after which it was supposed to lie for two hours in a warm place [15]. The people gave buckwheat to cows with bloody urine. According to the observations of K.S. Gornitsky, cows, indeed, were cured "from one, many - from two times" [15]. Until now, in folk medicine, it is considered that due to the high content of B vitamins, buckwheat is useful for nervous diseases, as well as for normalizing the activity of the intestines, stomach, liver; prevents the development of rheumatism and atherosclerosis [8].

4.2. Application in modern medical practice

According to physiologically sound nutritional standards, each person should consume 7.5 kg of buckwheat per year. In terms of nutritional value, therapeutic, dietary and taste qualities, it occupies one of the first places among cereals [38], while it also has high consumer properties: a short cooking time (15–20 minutes for unground kernels, 10–12 minutes for prodel), a significant increase in volume (4.5–5.7 times) during cooking and excellent taste of the porridge obtained from it [18]. Porridge of a crumbly consistency is obtained from the groats of the kernel, and both a crumbly and liquid consistency is obtained from the prodela [18]. 100 g of buckwheat can satisfy the daily human need: in protein by 14.2%; in amino acids - by 16.1, including in essential amino acids - by 15.3; in carbohydrates - by 15.3; in vegetable fat - by 9.4; in thiamine by 30.3; in vitamin P - by 24.6; in choline - by 23.5; in vitamin E 33.2; in phosphorus - by 29.8; in copper - by 32; in magnesium - by 50; in iron - by 57%. Particularly valuable is the high content in buckwheat of dietary fiber, unsaturated fatty acids (essential compounds that play an important role in metabolism, with extremely limited capabilities of the human body to synthesize them), lecithin, essential vitamins and minerals [18].

In modern medical practice, buckwheat groats are included in the diet for depletion as a source of vitamin P (rutin) [86], obesity, diabetes, iron deficiency anemia, nervous system disorders, diseases of the kidneys and gastrointestinal tract, and general strengthening diets at any age [19, 38]. The main type of action is angioprotective (rutin) [26]. It is believed that buckwheat is especially useful for gastrointestinal diseases, iron deficiency anemia, kidney disease [38], leukemia [44]; positive effect on performance

nervous system [18]. Regular consumption of buckwheat porridge strengthens blood vessels [44], lowers cholesterol and total blood lipids, prevents the development of atherosclerosis, and prevents fatty degeneration of the liver [4, 11, 87]. O. Blaze (2000) also refers to the main medicinal properties of buckwheat the ability to remove radionuclides from the body [44]. Buckwheat is indispensable in the nutrition of athletes and people involved in heavy physical labor. Gerontologists recommend its regular use for nutrition for the elderly; on its basis, food is prepared for young children [18].

There are data on the biological effect of some groups and individual biologically active substances in buckwheat. In particular, folic acid, in combination with other biologically active substances, stimulates hematopoiesis [26, 44], increases endurance and body resistance [44]. Vitamin PP (nicotinic acid) stimulates the work of the hematopoietic organs, stomach, intestines, liver, improves the immune status. Vitamin B1 is involved in the regulation of the activity of the nervous system [8], dietary fiber and the entire polyphenol and vitamin complex - the level of glucose in the blood [19].

Buckwheat lecithin stimulates the development of a growing organism and hematopoiesis, favorably affects the activity of the nervous system, liver, increases the body's resistance to the action of toxic substances, and prevents the development of atherosclerosis [18]. Participating in the regulation of cholesterol metabolism, lecithin contributes to the breakdown and removal of cholesterol from the human body [18].

Miliacin (3-β-methoxy-Δ18-oleanene) is a pentacyclic triterpenoid with a wide range of biological effects, in particular, medicinal properties [52]: immunotropic, anti-inflammatory, antiglycemic; normalizes the work of liver and blood serum enzymes, stimulates the growth of a young organism [88]. The expediency of its use in the complex treatment of acute varicothrombophlebitis has been shown [89]. Due to the established immunoprotective [90–93] and hepatoprotective [94, 95] properties, in the future it can be used in chemotherapy of cancer patients [96]. In particular, O.V. Kalinina et al. (2009) in the experiment it was convincingly shown that that miliacin increases the therapeutic efficacy of methotrexate and, when combined with it, causes a high inhibition of the growth of LLC tumors within 12 days after the administration of the cytostatic. Methotrexate in combination with miliacin increases the lifespan of mice with LLC by 36%, while methotrexate in monotherapy only by 9%, while reducing the toxic effect of methotrexate on the body of mice with LLC tumor, reducing the death of animals up to 13% [94, 96]. It is well tolerated in the dose range from 2 to 1000 mg/kg: LD_{50}miliacin is more than 1000 mg/kg, which indicates the absence of toxic properties in it [52, 94].

Under conditions of acute intoxication of the body with carbon tetrachloride, miliacin caused a decrease in necrotic and dystrophic changes in the liver, and also contributed to the acceleration of regenerative processes in it [97]. Subsequently, its ability to provide a membrane stabilizing effect [93, 97, 98] and reduce lipid peroxidation processes (LPO) was demonstrated [90, 97, 99]. At the same time, reducing the risk of side effects of chemotherapy may be of practical interest only if the triterpenoid does not reduce the antitumor effect of a particular chemotherapy drug [97].

The physiological effect of dietary fibers is due to their high sorption properties, in particular, the ability to retain water [18]. Nucleus and prodel, rich in fiber, regulate intestinal motility and are prescribed for atony and persistent, difficult to treat constipation. Smolensk groats have a more gentle effect on the gastrointestinal tract; it is recommended for patients with gastric ulcer, gastritis, diseases of the intestines, liver and biliary tract [11]. When choosing buckwheat for dietary purposes, it should be borne in mind that the color and taste of porridge depend on the rigidity of the TRP regimes for cereals. The TRP process changes the color to brown, reduces the cooking time, and somewhat increases the coefficient of groats' digestibility [37].

Very ambiguous data were obtained at the Research Institute of Nutrition of the Russian Academy of Medical Sciences (FRC of Nutrition and Biotechnology) regarding dietary fibers [100]. On the one hand, insufficient intake of vitamins, microelements, and biologically active minor food components leads to the development of immunodeficiency states, which mediate a decrease in resistance to infectious diseases and oncopathology [101, 102]. On the other hand, the enrichment of a vitamin-deficient diet with dietary fiber in doses corresponding to the upper acceptable intake level can lead to further deterioration of the vitamin status [103, 104]. Therefore, food products containing dietary fiber in combination with a natural natural complex of vitamins in native ratios, namely cereals, in particular buckwheat, are of particular importance.

According to Chinese experts, the medical properties of buckwheat are mainly associated with flavonoids and fagopyrol. The content of flavonoids in Tatar buckwheat is higher than in sowing buckwheat. Flavonoid-containing preparations with a high content of copper, which improves iron function, are used to prevent iron deficiency anemia in the form of capsules, tablets, medicinal cereals (electuary) [41].

4.3. Contraindications and precautions for the use of buckwheat

According to modern data, infusion and tincture of flowers and herbs are contraindicated in thrombophlebitis [4, 19]. There is information about the toxicity of fresh leaves and flowers [4, 19].

Use in celiac disease and allergic risks. One of the main features of buckwheat is the complete absence of gluten (gluten) [105, 106], and therefore it can be included in the diet of patients with celiac disease or gluten allergy. Buckwheat, like quinoa or amaranth, consumed in moderation, does not cause problems in most patients with celiac disease [106].

According to some publications, the content of some proteins similar to those contained in

wheat gluten, but according to [107], alcohol-soluble “buckwheat proteins have little molecular similarity to wheat prolamins, therefore, their description as “gluten” or “gliadin” is unreasonable and, unfortunately, can lead to unreasonable exclusion of valuable sources of dietary protein from the diet of sensitive people."

Immunological studies have established that buckwheat proteins, regardless of its variety, do not pose a danger to patients with celiac disease, since they do not have a homologous protein structure with wheat and do not contain toxic prolamins. Electrophoregrams reliably demonstrate the similarity of some protein bands of buckwheat proteins with legume proteins [61]. The allergenic properties of buckwheat were studied using an indirect enzyme immunoassay with antibodies to wheat germ lectin. It was found that properly processed (husked) buckwheat and buckwheat flour obtained from it did not react with serum containing antibodies to wheat germ lectin, which makes it possible to use them in the diet therapy of patients with celiac disease [61]. Unless disruptions are also allowed in the process of growing and supplying grain, it is very unlikely that that buckwheat can be contaminated with wheat gluten [107]. Buckwheat is approved as a dietary gluten-free diet in Canada, Europe, and Australia [107].

However, allergological risks remain with respect to other buckwheat proteins. According to the WHO/IUIS Allergen Nomenclature, to date, allergenic components have been identified for Fagopyrum esculentum (Common buckwheat): 1) Fage 2. Biochemical name: 2S albumin, molecular weight 16 kDa; 2) Fag e 3. Biochemical name: Vicilin, molecular weight 19 kDa (fragment). For Fagopyrum tataricum (Tartarian buckwheat), an allergenic component was identified: Fag t 2. Biochemical name: 2S albumin, molecular weight 16 kDa [21].

Informing doctors and patients at risk of developing allergic reactions and/or intolerance is an extremely important aspect of preventing the occurrence of critical situations for both patients and people who consider themselves healthy people [22, 23]. It is especially important to assess the potential allergological risks of foods in children. In particular, according to [108, 109], buckwheat is one of the most common allergens in children with atopic dermatitis, occurring in 20.5% of cases (n = 181). In general, the frequency of sensitization to buckwheat (n = 525) is 15.4% [108, 109].

It is important to note that the assessment of allergological risks in the food industry in developed countries is becoming an indispensable element in the development and production of food products [110, 111].

Compatibility with other food products. According to the theoretical concepts of the modern "Western" dietetics, buckwheat goes well with animal products such as milk, meat, cottage cheese, which allows you to create highly nutritious combinations that are balanced in amino acid and fractional composition of proteins, as well as in fatty acid composition, richer in vitamins and minerals [18]. At the same time, in traditional dietology, there are clear restrictions on the joint use of buckwheat with a number of foods.

In particular, from the standpoint of Tibetan and traditional Chinese medicine, it is forbidden to consume buckwheat simultaneously with some meat protein products - lamb [9, 112], pork liver [9], pork [9, 112], wild duck meat [9]. In general, combinations of buckwheat as a starch, with proteins, especially animals (for example, like bread with meat or potatoes with fish), with milk and sour-milk products (for example, like porridge with milk or kefir with bread), with sugars (for example, as a bun with jam or porridge with sugar), with any fruits and fruit juices [113, 114]. In the Ayurvedic tradition, combinations of buckwheat as a starch, with melon, bananas, milk, yogurt are also not allowed [12, 114]. In a separate diet, it is not recommended to use buckwheat with other concentrated starchy foods: with cereals,

5. Green buckwheat

In the last decade, there has been a clear desire of consumers to use the so-called green buckwheat, or buckwheat grain (unground buckwheat), which has not been subjected to TRP. A large number of practically unproven publications about the benefits of green buckwheat without reference to primary sources are posted on the global Internet, for example [34]. In this section of the work, we have made an attempt to objectify the available information.

“Green buckwheat” is a cereal product that does not require steaming [27, 32], while the grain retains its ability to germinate [28]. From green buckwheat, in addition to the core, prodel [32], flakes (green buckwheat flakes) [116] and bran (medium and fine grinding) [105] are obtained.

Green buckwheat flakes are a multicomponent system in which the ability to swell is mainly due to proteins, starch and fiber [116]. Flakes are rich in proteins, carbohydrates, vitamins, macro- and microelements. They are an important raw material source that increases the nutritional and biological value of food products [116].

The raw material for the production of buckwheat bran (TU 9295-001-63528860-2012) is unboiled and uncalcined buckwheat seeds (zelenets), from which dark membranous shells (husks) have been removed [105]. Buckwheat bran is poor in carbohydrates, rich in protein (up to 40%) and soluble fibers. They are considered more useful than other bran, since the protein is similar to animal protein, fats are not deposited, but are immediately consumed in the body for their intended purpose [105].

5.1. The chemical composition of green buckwheat

Exploring the nutritional value of buckwheat of various shades, V. Maryin and A. Vereshchagin (2011) showed that

that the modes of processing of buckwheat (the duration of steaming) affect not only its color, but also its chemical composition. In particular, while maintaining the consumer indicators of buckwheat porridge (appearance, texture, color, smell, taste, digestibility coefficient), the content of essential and non-essential amino acids decreases even with an increase in the duration of steaming the original cereal from 5 to 11 minutes [117]. The chemical composition of brown and green buckwheat also differs in a number of other indicators (Tables 8, 9, 11).

Table 9

The chemical composition of buckwheat grain and products of its processing [20]

Sample	Content, %					
	moisture	Belkov	carbohydrates	food fibers	Zhirov	Ash content
Buckwheat	14–15.2	12.5–13.6	55.8–60.2	9.8–11.1	1.4–1.6	2.1–3.3
Core*	12.4–14	13.1–15	62–66.1	2.3–2.9	3.2–4	1.9–2.1
Nucleus	11–13.2	13.4–14.6	62.7–68.9	1.5–2.8**	3.2–4.2	1.8–2.7
Muchka	8.2–10.2	22.5–30	31.1–42.8	14.2–14.8	5.2–7.5	6.5–7
Grain waste	13.4–15	8.4–11	35.2–44.5	28.7–32.2	1.6–2.8	3.4–3.8
Husk	8.8–9.2	4.2–5.6	21.2–31.2	52.2–57.4	1–1.3	2.6–5.3

* The core, not subjected to hydrothermal treatment.
* * According to I.M. Skurikhin, the content of dietary fiber is 11.3% [30; 71].

Carbohydrates (starch, etc.), as the main component of cereals of all kinds, serve not only as the main energy material, but also affect the cooking properties and digestibility of the product [64]. A change in the composition of carbohydrates may indicate a decrease in the quality of cereals [118].

The consistency of finished products depends on the properties of starch and the ratio of amylose and amylopectin in it. For example, rice varieties with low amylose content have low cooking properties - a short gelatinization time and maximum viscosity. Under the action of high temperatures, cereal starch is dextrinized with the formation of polysaccharides, and upon further hydrolysis, into sugars (maltose and glucose) [118]. The content of native starch is reduced by 1.2–1.4 times. Due to the partial dextrinization of starch, the duration of cooking cereals is reduced [64]. When the product is heated within 50–60 °C, the starch content decreases slightly - by 2–3%, and when the product temperature increases to 75–95 °C (for example, with buckwheat TRP) - by 9–12%, as a result of which, with positions of technologists, consumer advantages of cereals are improved (cooking time, consistency). Along with the hydrolysis of starch, there is a simultaneous increase in the content of sucrose and reducing sugars, which characterizes an increase in the nutritional value and efficiency of the assimilation of cereals from the standpoint of classical dietology [64]. The reducing sugars include glucose and fructose, and the content of glucose in cereals prevails over fructose. During the hydrolysis of starch, dextrins, maltose and glucose are formed. The content of sucrose also increases due to the hydrolysis of polysaccharides [64]. During the hydrolysis of starch, dextrins, maltose and glucose are formed. The content of sucrose also increases due to the hydrolysis of polysaccharides [64]. During the hydrolysis of starch, dextrins, maltose and glucose are formed. The content of sucrose also increases due to the hydrolysis of polysaccharides [64].

From the point of view of food technologists, an increase in sugar content due to starch hydrolysis has a positive effect on the physiological properties and digestibility of products [64]. At the same time, nutritionists, when choosing buckwheat for a particular patient, should take into account the biochemical changes that occur in it during the TRP process. In particular, from Table. Figure 9 shows that the total amount of carbohydrates in green buckwheat and cereals after the TRP is approximately the same in terms of the lower limit, but the upper limit is significantly higher after the TRP. At the same time, from Table 8 it can be seen that the starch content in cereals after TRP is significantly lower compared to green buckwheat (65 and 68%, respectively).

The main components of the dietary fibers of the green buckwheat plant complex are cellulose, non-starch polysaccharides, lignans. The total content of dietary fiber in the seed is 5–11% [35] (according to other sources, 14% [33]), with a predominance of soluble fiber. Polysaccharides are represented by glucuronic acid, mannose, arabinose, galactose, and glucose [35]. It turned out to be difficult to assess the content of dietary fibers in green buckwheat and groats after the TRP (in a comparative aspect) according to the available data, since different bibliographic sources provide the results of analyzes performed using different methods, and often different groups of dietary fibers were evaluated.

The protein content (of the highest quality) in green buckwheat is in the range of 13.0–15.0%; in terms of biological value, it is equal to the protein of meat, fish, eggs; contains 18 essential amino acids; in terms of its general composition, it can be compared with the proteins of leguminous plants [35].

Among plant sources, green buckwheat has one of the highest scores in terms of amino acid composition [64]. The content of amino acids (%) in green buckwheat is: tryptophan - 0.192, threonine - 0.506, isoleucine - 0.498, leucine - 0.832, lysine - 0.672, methionine - 0.172, cysteine - 0.229, phenylalanine - 0.520, tyrosine - 0.241, valine – 0.678; arginine – 0.982; histidine – 0.309; alanine – 0.748; aspartic acid – 1.133; glutamic acid – 2.046; glycine – 1.031;

The protein fraction consists of albumin 18.2%, globulin 43.3%, prolamine 0.8%, glutelin 22.7%, etc. - 5.0%. The most important property of buckwheat proteins is their good solubility and digestibility [64].

According to modern concepts, proteins are one of the most nutritionally valuable components of food products. The biological value of proteins is an integral indicator, which is determined by the quality and quantity of protein in the diet, protein digestibility by gastrointestinal proteinases, amino acid absorption rates and subsequent utilization of amino acids for the plastic needs of the body. Heat treatment of food products (in this case, the TRP of buckwheat) significantly affects their protein content.

complex. Under the action of high temperature, protein denaturation occurs, which leads to an increase in the efficiency of its cleavage by enzymes: the more intense the protein denaturation, the higher the rate of its cleavage and the better its digestibility [64].

The change in protein content may be associated with a decrease in the amount of water-soluble proteins as the most thermolabile fraction, and with their partial denaturation. Heating the product to 40°C causes a slight decrease in the amount of proteins, while increasing the temperature to 70–95°C reduces their content by 30%. This is due to the fact that water quickly penetrates between the structural components of protein molecules and their dissolution occurs. Such proteins, unlike dry ones, become an object for dielectric heating and denaturation [64]. The protein content in buckwheat subjected to GTO differs from the initial protein complex [64], but this is not entirely consistent with the data obtained by other researchers [37] (Table 8). Data on the content of individual protein fractions in green buckwheat also differ from different authors [35, 37] (Tables 8 and 9).

The protein content in green buckwheat flakes varies between 13–15%. The protein fraction is represented by albumin - 18.2%, globulin - 43.3%, prolamine - 0.8%, glutelin - 22.7% and 5% of other components. Albumins are highly soluble in water and saline solutions. Therefore, swelling for them, especially at elevated temperatures, is the first stage of dissolution (unlimited swelling). Globulins are insoluble in water, but soluble in aqueous solutions of neutral salts [116].

The composition of green buckwheat flakes includes the following amino acids (%): lysine (5.1), methionine (1.9), cystine (2.2), threonine (3.5), valine (4.7), isoleucine (3 .5), leucine (6.1), phenylalanine (4.2), histidine (2.2), tryptophan (1.6) [116].

Table 10

The chemical composition of green buckwheat (food buckwheat *) according to various sources

Nutrient	Quantity per 100 g					
	[35, 116]	[twenty]	[37]	[119]	* [31]	Groats after TRP [31]
Squirrels	12.6 g	13.1–15.0 g	13.4 g	13.25 g	10.8 g	12.6 g
Proteins by fractions (in % of the total):						
– albumins	18.2		22.7			
– globulins	43.3		25.6			
– prolamins	0.8		11.5			
– glutelins	22.7		17.1			
– insoluble	5.0		23.1			
Fats	3.3 g	3.2–4.0 g		3.40 g	3.2 g	3.3 g
Carbohydrates	62.0 g	62.0–66.1 g		71.5 g	56.0 g	57.1 g
starch			67.7 g		54.1 g	55.4 g
Water/Moisture	14.0 g	12.4–14.0 g		9.75 g	14.0 g	14.0 g
Alimentary fiber	1.3 g	2.3–2.9 g		10.0 g	14.0 g	11.3 g
Ash content		1.9–2.1 g		2.1 g	2.0 g	1.7 g
Vitamins:						
A	6.0 µg			0		
Carotene					10 mcg	10 mcg
Retinol equiv.				0	2 mcg	2 mcg
IN 1	0.4 mg			0.101 mg	0.3 mg	0.43 mg
IN 2	0.2 mg			0.425 mg	0.14 mg	0.2 mg
B3 (niacin)					3.9 mg	4.2 mg
Niacin equiv.					6.2 mg	7.2 mg
AT 6	0.4 mg			0.210 mg		
AT 9	31.8 mcg			30 mcg		
E	6.7 mg					
Tocopherol equiv					0.8 mg	0.8 mg
RR	4.2 mg			7.02 mg		
Macronutrients:						
Calcium	20.7 mg			18 mg	70 mg	20 mg
Magnesium	200.0 mg			231 mg	258 mg	200 mg
Sodium	3.0 mg			1.0 mg	4.0 mg	3.0 mg
Potassium	380.0 mg			460 mg	325 mg	380 mg
Phosphorus	296.0 mg			347 mg	334 mg	298 mg
Chlorine	34.0 mg					
Sulfur	88.0 mg					
Trace elements:						
Iron	6.7 mg			2.2 mg	8.3 mg	6.7 mg
Zinc	2.0 mg			2.4 mg		
Iodine	3.3 mcg					
Copper	640 mcg			1.1 mg		
Manganese	1.56 mg			1.3 mg		
Chromium	4.0 µg					
Fluorine	23.0 mcg					
Molybdenum	34.4 mcg					
Silicon	81.0 mg					
Cobalt	3.1 mcg					
Selenium				8.3 mcg		

The importance of fats in the diet is due to their high energy value, as well as the participation in the metabolism of essential unsaturated fatty acids. The unsaturated fats contained in buckwheat are highly digestible [120]. In products of plant origin, the fat content is small fractions of a percent, compared to products of animal origin. Despite this, the fat content must be taken into account when studying the nutritional value of cereals [64]. For example, when rice grains are heated to a temperature of 30–60 °C at an average power and an exposure of 120 seconds, the total fat content increases by more than 4% [64]. Perhaps a similar situation is observed with buckwheat, but we did not find specific data in the available literature.

Vitamins. Raw buckwheat contains vitamin E, nicotinic and pantothenic acids, thiamine, riboflavin (Table 1). 10, 11) and a significant amount of rutin [35] (in the USA, the estimate is based on the amount of its aglycone quercetin – Table 11).

Table 11

Comparative analysis of the chemical composition of green buckwheat and cereals subjected to heat processing (in terms of dry weight) according to USDA - US National Database [119, 121]

Nutrient	Units	Value per 100 g of product		Value for 1 serving	
		Groats after heat treatment	Green buckwheat	Groats after heat treatment	Green buckwheat
Water	G	8.41	9.75	13.79	16.58
Energy value	kcal	346	343	567	583
Protein	G	11.73	13.25	19.24	22.52
Common Fats	G	2.71	3.40	4.44	5.78
Carbohydrates	G	74.95	71.50	122.92	121.55
Dietary fibers	G	10.3	10.0	16.9	17.0
Minerals					
Calcium	mg	17	eighteen	28	31
Iron	mg	2.47	2.20	4.05	3.74
Magnesium	mg	221	231	362	393
Phosphorus	mg	319	347	523	590
Potassium	mg	320	460	525	782
Sodium	mg	eleven	one	eighteen	2
Zinc	mg	2.42	2.40	3.97	4.08
Copper	mg		1.10		1.87
Manganese	mg		1.30		2.21
Selenium	mcg		8.3		14.1
vitamins					
Thiamine (B1)	mg	0.224	0.101	0.367	0.172
Riboflavin (B2)	mg	0.271	0.425	0.444	0.722
Niacin (B3, PP, a nicotinic acid)	mg	5.135	7.020	8.421	11,934
pantothenic acid (B5)	mg		1.233		2.096
AT 6	mg	0.353	0.210	0.579	0.357
folate	mcg	42	thirty	69	51
Fats					
Fatty acid: rich	G	0.591	0.741	0.969	1.260
monounsaturated	G	0.828	1.040	1.358	1.768
polyunsaturated	G	0.828	1.039	1.358	1.766
cholesterol	mg	0	0	0	0
Flavonoids					
Flavonols: Quercetin	mg		15.4		26.1
Proanthocyanidins: dimers	mg		5.8		9.8
trimers	mg		1.6		2.7

From the data in Table. 10 and 11, it can be seen that in the process of heat treatment, the content of some vital biologically active substances increases, contrary to popular beliefs. In particular, the content of B vitamins - thiamine, riboflavin, niacin - increases (Table 10).

Minerals (Table.10, 11). According to some reports, heat treatment does not lead to significant changes in the content of calcium and phosphorus in buckwheat [64]. At the same time, from the data in Table It can be seen from Table 10 that the amount of potassium increases after HTO, while the content of iron, phosphorus, magnesium, calcium, and sodium decreases (Table 10).

5.2. The biological effect of green buckwheat

Since the composition of biologically active substances in buckwheat grains does not change significantly during the TRP, it can be assumed that the main types of biological action of green buckwheat will differ slightly from classically processed cereals. However, taking into account the data on the dynamics of specific groups of biologically active substances [64], we considered it appropriate to present the revealed information on the biological activity of green buckwheat.

In bibliographic sources, we found experimentally and clinically unconfirmed data that the proteins that make up green buckwheat help cleanse the body of radioactive substances and normalize the growth of the child's body [34, 35, 120].

Since the water-soluble (albumins) and salt-soluble (globulins) fractions of cereals are considered the most valuable (they are more susceptible to the action of stomach and intestinal enzymes, therefore, they are more easily and completely absorbed by the human body [35, 58, 59]), and during hydrothermal treatment, the relative content of these fractions in the total amount of protein decreases significantly (Table 8 [37]), by indirect evidence, we can judge the higher protein value of green buckwheat, compared to the kernel.

Green buckwheat is a source of essential amino acids; green buckwheat protein has the highest biological value among the proteins of other plants in the complete absence of gluten (gluten) [105]. Data on the chemical composition of green buckwheat are contradictory (Table 10).

According to [116], green buckwheat contains many flavonoids that are effective in lowering blood cholesterol levels and preventing high blood pressure. Therefore, it has a “life-giving” effect on blood vessels, including due to the high content of rutin (seals the walls of blood vessels, helps stop bleeding, has a preventive and therapeutic effect on veins), improves blood circulation (rich in magnesium), helps reduce blood pressure and blood levels. cholesterol in the blood [35]. The presence of rutin, quercetin, orientin, vitexin, isovitexin, and isoorientin was also found in green buckwheat flakes [116].

Due to the presence of the whole valuable complex of biologically active substances and, in particular, inositol, green buckwheat helps to normalize metabolism and improve the function of the digestive system, has a hypoglycemic effect and is used for diabetic nutrition [35]. Green buckwheat flakes also contain chiroinositol, which activates insulin and reduces blood glucose levels [116].

The total content of dietary fiber in green buckwheat seed is 5–11%. The main components of dietary fiber are cellulose, non-starch polysaccharides represented by glucuronic acid, mannose, arabinose, galactose, glucose, and lignans [116]. Groats are in 3rd place among cereal crops in terms of the amount of lignans produced, which have a phytoestrogenic effect [116]. According to some data, it is green buckwheat that helps protect the body from cancer, including due to the presence of lignans in the grain, which are transformed into enterolactone in the intestine [33, 35, 122].

Soluble fiber predominates in green buckwheat flakes [116]. Buckwheat bran suppresses appetite, creates a favorable intestinal microflora, contributes to the normalization of blood glucose levels, lowering blood pressure; remove toxins, toxic salts and heavy metals [105].

Thus, taking into account the biochemical changes occurring during the TRP process (especially in case of violations of the technological regulations due to an increase in temperature and duration of the TRP processing of grain, as well as the use of microwaves in the production process), the use of green buckwheat may reduce the likelihood of using cereals with reduced nutritional and energy (from the standpoint of traditional medicine) properties. Like cereals, after TRP, during long-term storage, green buckwheat does not go bitter and moldy at high humidity [35].

conclusions

1. An information and analytical study of traditional and modern scientifically based approaches to the medical and food use of buckwheat and Tatar buckwheat.

2. It is shown that buckwheat is a valuable traditional food product in Russia, and its medicinal preventive use has a modern scientific justification and a specific list of indications for medical use.

3. Significant differences in the chemical composition and biological value of green buckwheat and groats that have undergone hydrothermal treatment, which today is the main product of buckwheat processing entering the trading network.

4. It is shown that despite the presence of GOST R 55290-2012 and a number of production rules, today the consumer is not insured against the purchase of buckwheat with reduced consumer properties (due to the increase in temperature and the duration of the hydrothermal treatment of grain, as well as the use of microwaves in the production process).

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