

Sowing rice (*Oryza sativa* L.) from the standpoint of traditional medicine and modern scientific concepts: food, energy, therapeutic and prophylactic properties, use in diabetes mellitus
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Rice in Traditional Medicine and recent scientific findings: nutritive, energy and preventive properties, benefits in diabetes
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SUMMARY

An information-analytical study of traditional and modern scientifically grounded approaches to the medical and food use of sowing rice has been carried out. It has been shown that sowing rice is a traditional food product and a medicinal product. Its biological properties and features of therapeutic and prophylactic use depend on the region of growth, time of harvest, degree of maturity and processing of grain. Differences in the chemical composition and biological value of brown rice and milled cereals (white rice) were revealed. It is shown that, despite the negative attitude of academic dietetics to the use of rice cereal (white rice) for diabetes, in traditional medical systems this type of rice is widely used in the prevention and treatment of diabetes, taking into account the constitutional type of the patient.

Key words: rice, rice groats, brown rice, white rice, polished rice, traditional medicine, nutrition, dietetics.

RESUME

We conducted an information and analytical study of traditional and modern scientifically based approaches to the medical and nutritional use of rice. We have found that rice is a traditional food and medicinal product. Biological properties of rice and features of its therapeutic and prophylactic use depend on the region of growth, time of collection, degree of maturity and technological processing of grain. Differences in the chemical composition and biological value of brown rice and grits that have undergone grinding (white rice) were revealed. It was shown that, despite the negative attitude of academic dietetics to the use of rice grains (white rice) in diabetes, in traditional medical systems, this type of rice is widely used in the prevention and therapy of diabetes, taking into account the constitutional type of the patient.

Keywords: rice, rice groats, brown rice, white rice, polished rice, traditional medicine, nutrition, dietetics.

INTRODUCTION

In various traditional medical systems of the world (Ayurveda, Unani, Siddha, traditional Chinese, Korean (Koryo), Tibetan medicine, etc.) food products, like cooked food, are among the most important remedies [1, 23, 28, 30, 32, 37, 50-52, 54-56, 63, 64, 68]. At the present stage of the development of world traditional medicine (TM), food is considered, among other things, as a source of biologically active substances (BAS), which have a pronounced physiological effect on the body. Moreover, the effect of the same food products, from the point of view of TM, in different cases can be both positive and negative, depending on the specific nosological form or symptom complex, the stage of development of the process, the region of residence of the subject, seasonality, individual characteristics of the organism, compatibility with other components of food and drugs [18,

Today, as in ancient times, TM specialists proceed from the fact that adequate nutrition based on a balanced intake of the main groups of macronutrients (proteins, fats, carbohydrates) and micronutrients (vitamins, macro and microelements, amino acids, flavonoids and other polyphenols, polysaccharides, unsaturated fatty acids) occupies a leading place among the methods of treatment and prevention of diseases [18, 19, 23, 25].

From ancient times to the present, cereals have been widely used in traditional dietetics for metabolic disorders, anti-stress therapy, disorders in the central regulatory triangle (nervous, endocrine, immune systems) and many other areas of phyto and pharmacotherapy [17, 18, 23].

From the standpoint of a number of traditional medical systems and modern academic concepts, sowing rice is a very controversial culture, especially in the treatment of patients with diabetes mellitus, patients with obesity and other metabolic disorders [22, 23].

The purpose of this information-analytical research consists in identifying, analyzing and generalizing traditional ideas and modern scientifically grounded data on rice as a medicinal plant and a source of several types of cereals of domestic and foreign production, imported into Russia.

MATERIALS AND METHODS

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

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

1. Producing plants, peculiarities of culture and prevalence of sowing rice

Sowing rice (*Oryza sativa* L.) is one of the most ancient food plants related to cereal crops [18, 36, 43]. Genus *Oryza* belongs to the family Myrtaceae (Poaceae), or Gramineae, and includes about 20 species growing mainly in the tropics and subtropics of South and East Asia, Africa, America, Australia. In culture, rice is also grown in the tropics, subtropics and warm regions of the temperate zone (up to 90% of crops are in Asia) [36, 44].

Rice culture arose in Southeast Asia more than 7 thousand years ago [18], according to other sources, the domestication of rice took place about 9 thousand years ago [43]. India and China are considered the most ancient centers of rice cultivation [3].

In our minds, traditional Chinese cuisine is strongly associated with rice, however, according to experts, it is hardly possible to talk about the widespread distribution of rice in ancient China. A fairly complete picture of the prevalence of agricultural crops in China in the 1st millennium BC. can provide an analysis of the frequency of their mention in one of the most ancient monuments of Chinese culture - the canon "Shi Jing" (Canon of verses, XI-VI centuries BC). In the text of this book, rice is mentioned only 7 times, which is much less frequent than mentions of chumiza, millet and even wheat [3, 23].

This is due to the fact that in ancient China, rice was not included in the daily diet of ordinary people in the Middle Kingdom. A grain of rice was a rare and valuable commodity, a luxury item on a par with the wearing of expensive brocade clothing. Millet and plague remained the main grain crops of Northern China until the reign of the Tang (618-906) and Song (960-1279) dynasties. Both of these crops filled the state granaries, and they also levied the tax. Only when, under the powerful pressure of the nomadic tribes, the Chinese population began to move from their ancestral lands to the south, rice gradually became the staple food for the inhabitants of the southern regions of China. The distinction in the diet of northern and southern Chinese persisted for centuries,

On the territory of the former USSR (Transcaucasia and Central Asia), rice has been grown since the 2nd - 3rd centuries BC, in Europe - from the 8th century BC, in America - from the 15th - 16th centuries [36, 44]. According to other sources, the Arabs brought the rice culture to Spain and at about the same time to Egypt at the beginning of the 7th century [18]. In West Africa, in addition to sowing rice (*Oryza sativa*) naked rice, or African rice (*O. glaberrima*). The grain of some wild-growing species, for example, dotted rice (*O. punctata*) and short-tongue rice (*O. breviligulata*), growing in Africa, is still used as food by the local population [36, 44].

The type of rice, glutinous rice, stands somewhat apart. This variety is popular in southern China and in the countries of Southeast Asia, it is much less known in other regions of the world. Includes glutinous varieties of sowing rice *Oryza sativa* L. var. *glutinosa* Mats. (synonyms: sticky rice, sweet rice). On the territory of the former USSR, sweet rice was not grown and was not available in retail chains, but recently Viola rice variety has appeared on the shelves (Table 2) - the first domestic glutinous rice variety bred at the All-Russian Research Institute of Rice and recommended for the development of special medicinal and baby food [3]. Glutinous rice differs from other varieties of rice both in the properties of cereals (Table 2) and biological action (see the section "Biological action, features of medicinal-pharmaceutical and dietary use of rice: the experience of traditional medicine").

Description of the plant. Sowing rice - annual plant 50-150 cm tall. Stems branch from the base, leaves are up to 50 cm long and up to 1 cm wide, green, purple or reddish. Inflorescences are multi-spike panicles, 10-40 cm long. Spikelets are erect, one-flowered, with short legs. The flowering scales are hard-skinned, longitudinally ribbed, the lower ones are often with spines. Fruits are scarious caryopses, compressed from the sides, less often - rounded, densely covered with flowering scales remaining after threshing [18].

It is a spring, thermophilic and very hygrophilous plant grown under irrigation (on rice irrigation systems) or in areas with high rainfall (at least 1800-2000 mm per year). For seed germination, the top layer of the soil is moistened, and during the tillering phase, emergence into the tube, and sweeping of the panicle, a layer of water of variable depth from 15 to 25 cm is created in the plots (checks) [36, 44]. Rice fields are flooded with water until the seeds are fully ripe in order to protect them from direct exposure to sunlight, and also as one of the means of weed control [43]. Before harvesting, water is discarded [36, 44].

Modern cultivation and consumption of rice. Largest sown areas *Oryza sativa* L. are found in India, China, Bangladesh, Indonesia. In the Russian Federation, rice is grown on the North Caucasus, in the Lower Volga region, in the Primorsky Territory, on the territory of the former USSR - in the republics of Central Asia, in Kazakhstan, in the south of Ukraine [36, 43]. Historically, in the Russian Federation, the cultivated areas for growing rice are very limited due to climatic features - they account for only 0.4% (according to 2009 data). The share in the gross grain harvest in the Russian Federation is 1%, of which 95.8% of the total Russian volume falls on rice grown in the Southern Federal District [13].

The share of Russia in the world rice harvest is only 0.2%. The main world rice producers today are China, India, Indonesia, Bangladesh, Vietnam and Thailand, which account for more than 75% of the harvest of this crop. The Philippines, Brazil, Japan, Pakistan, USA, Egypt and South Korea are also major rice producers. According to the estimates of the Organization for Economic Cooperation and Development (OECD), the world rice production in 2013 was 494 million tons. [48]

Average annual rice yield in the world for the period 2006–2013, amounted to 43 centners per hectare of harvested area. The highest rice yield is recorded in Egypt - 97 c / ha, in Australia - 91 c / ha, USA - 78 c / ha, Turkey - 76 c / ha. In key producing countries, the yield is as follows: China - 65 c / ha, India - 33 c / ha, Indonesia - 48 c / ha, Bangladesh - 41 c / ha, Vietnam - 51 c / ha, Thailand - 29 c / ha. In Russia for the period under review, this figure was 48 c / ha. The rice yield in Russia in 2013 was at the level 49.6 c / ha, in 2012 - 54.9 c / ha [Cit. According to: 48].

Today all over the world a wide range of products is obtained from rice grains - various cereals, starch, oil (from germs); from straw - paper, cardboard, wicker products; the bran is fed to animals [18, 36, 41, 44].

At the end of the 20th century, rice was considered the main grain crop for a sixth of the world's population [36, 44]. In the 21st century, rice is still popular, as it was many centuries ago. It traditionally accounts for the main share in the world consumption of cereals (42%) [13], and, according to foreign data, it is the main grain crop for more than half of the world's population [73].

Rice consumption in Russia is approximately 5.2 kg per person per year, in China - 78.5 kg per person per year [13]. In the UK, 5.6 kg of rice per person per person per year (2012), but there is a constant increase in the consumption of this cereal as a result of the growing ethnic population and food diversification, with 80% of the population of this country buying mainly white rice [73]. In Asia as a whole, rice production reaches 150 kg per person per year [4, 9, 18, 19, 41].

In many densely populated areas of the Earth, rice remains the main, and sometimes the only food product, and in this regard, it finds a wide variety of applications [18, 41]. For example, in addition to the above uses, rice is used in brewing, in the east - for the production of rice vinegar [18]; rice vodka (sake) is a traditional alcoholic Japanese drink [4, 9, 18, 19, 41].

2. Rice groats

Today, on various equipment in the world, several types of processed rice are produced [7, 43]. Therefore, the consumer, as well as the representatives of the medical community, often has confusion associated with the definition of the type and variety of rice and the terminology: brown rice, round grain, glutinous rice and other varieties of rice are representatives of the genus *Oryza*, and also wild rice, or *Zizania*, not belonging to the genus *Oryza*. The culture of *Zizania* is dedicated to our separate publication [21].

The structure of a grain of rice is the same for all varieties of rice: the embryo of a new plant and a snow-white rice grain containing starch is located under a layer of brownish bran shell, in which vitamins, minerals and other nutrients are concentrated. The bran casing is protected by a tough yellow husk. Taken together, this is a grain of unhulled rice that is being processed. At different stages of this processing, rice changes its appearance and acquires different taste qualities [13].

The technology of processing rice into cereals in Russia, as well as throughout the world, includes a number of operations, each of which in a certain way affects the composition and properties of the products obtained. The main operations in the production of most cereals are: cleaning grain from impurities; hulling or peeling of grain; sorting of peeling products; grinding or polishing; cleaning and sorting, packaging [6–8, 13]. In general, the production of the entire variety of rice groats is as follows.

From the rice field, rice is brought to production, or unhulled rice. This is followed by drying and separation of the grain from the rice straw and weeds. Unhulled rice can be stored for several years, but a year after harvesting, it loses some of its natural aroma and acquires a yellowish tint [13].

The following regulatory requirements are imposed on the rice grain supplied for processing: moisture content no more than 15.5%; content of weed and grain impurities no more 2.0% each; kernel content - not less than 74% (that is, filminess - not more than 26%). With an increase in the grain size, its hulliness decreases, which means that the yield of cereals increases. After cleaning, the content of trash in a batch of rice should be no more than 0.4% [53].

Modern technology for the production of rice groats includes cleaning the rice grain from impurities with preliminary dividing the grain mass by size into two fractions (leaving a sieve with holes \varnothing 3.6–4.0 mm and the passage of this sieve) and subsequent cleaning of each fraction on separators, sifting A16PY with the release of small grain, double winding on aspirators [48]. Rice also goes for hulling in two fractions - coarse and fine [13].

Hulling - the first stage of processing is the removal of rice hulls, which makes up about 20% of the weight of unhulled rice and protects the grain from damage [13, 48]. Peeling is carried out on supplies with abrasive working bodies and on peeling machines with rubber rolls [6, 7, 13]. The results of rice hulling in machines with rubberized rolls and in a hulling stand (according to [31]) are presented in table. 1.

In 2014, a patent was published for a new domestic design of a centrifugal grinder [39]. The proposed machine for hulling grain, in particular rice, contains a rotor with blades, loading and unloading pipes installed in the deck body, a drive for rotating the rotor and disks with a variator. In order to improve the quality of grain hulling by reducing the amount of crushed kernel, it is equipped with discs made of various materials - one abrasive, the other made of rubber, and the edges of the inner surfaces of the discs have cuts at an angle of 15–20°, while the discs rotate in opposite directions, and the deck is lined elastic material [48].

Rice hulling results in machines with rubberized rolls
and in a peeling stand (according to [31])

Table 1

Index	Composition of products,% of total		
	Before peeling	After peeling	
		In the machine with rubberized rollers	In a peeling set
Unshelled grain	96.20	10.60	10.20
Hulled grain (kernel)	3.8	68.74	67.5
Crushed core	-	2.40	4.5
Flour	-	1.56	1.78
Husk	-	16.70	16.02
Total	100,00	100,00	100,00
Peeling Ratios	-	89.9	89.6
Core Integrity Coefficients	-	0.947	0.915
Total odds peeling,%	-	84	82

Improving the quality of peeling products using the proposed machine is achieved as a result of uniformity of peeling due to the creation of two zones of grain processing, as well as operational regulation of the degree of peeling and the formation of a uniformly distributed grain flow at the exit from the housing, which makes it possible to increase the efficiency of separation of peeling products [39]. Only a combination of essential features available in the machine proposed by the authors of the patent allows achieving the set goal due to the fact that at the entrance of the grain there are installed movable disks with opposite rotation, having cuts, and at the exit - a vane rotor with a deck lined with elastic material to ensure uniform soft peeling grain [48].

Thus, the working part of the disks installed at the inlet treats the surface of the grain with a minimum force of pressure, then it is thrown by the rotor blades onto the elastic lining of the deck at the outlet, which creates an increase in the working surface and the time of the peeling process due to the creation of two zones of grain processing, which provides improving the quality of peeling products [38, 48].

After the first stage of processing (peeling), brown rice [6, 7, 13], consisting of whole grains of rice, goes on sale. The characteristic brown hue and nutty flavor is given to it by the bran shell, which remains on the grain during the peeling process [13].

Milled rice is obtained by further processing of hulled rice grains on grinders. The grains of polished rice have already completely removed the flowering, fruit and seed coats, most of the aleurone layer and embryo. The surface of the polished rice is rough, therefore, at the next stage of processing, polished rice is obtained from it, the surface of which is smooth and shiny. That is, grains of polished rice are grains of polished rice processed on polishing machines, produced from glassy varieties [6, 7, 43], other varieties are presented in table. 2.

Crushed rice is crushed rice kernels formed during the production of milled or polished rice (in fact, these can be defective, broken grains, rice, chaff), additionally processed on grinding machines and did not pass through a sieve with apertures of 1.4 mm [6, 7, 43].

Parboiled rice. Rice processing with steam, which is widely used today, is one of the technologies aimed at improving its quality characteristics. [13]. To produce parboiled rice, the unhulled rice received for production is soaked in water and then treated with hot steam under pressure. The grains that have gone through this procedure are dried and polished like ordinary rice. After processing, the grains of parboiled rice acquire an amber-yellow hue and become translucent [6, 7, 43].

Types and subtypes of rice (according to [45])

table 2

Type of			Subtype		An indicative list of varieties characterizing the type and subtype
No.	Name vanie	Attitude length to width not peel leg grain	No.	Grain consistency	
I	Long grain	3.2 and more	1	Vitreous	Volgogradsky, Emerald, Primorsky 29, Light, Serpentine, Snowflake, Khankaisky 429, Khankaisky 52
			2	Partially vitreous	Partially vitreous varieties
			3	Milk glass in cut stearin-like without mealy or vitreous blotches	Glutinous varieties
II	Average grain	2.3-3.1	1	Vitreous	Amethyst, Kurchanka, Leader, Novator, Regulus, Fountain, Amber
			2	Partially vitreous	Partially vitreous varieties
			3	Milk glass in cut stearin-like without mealy or vitreous blotches	Glutinous varieties
III	Short grain	2.2 and less	1	Vitreous	Atlant, Boyarin, Victoria, Bend, Gamma, Garant, Far East, Darius 23, Amicable, Commander, Contact, Kuban 3, Idol, Estuary, Lugovoy, Priozerny 61, Razdolny, Rapan, Severny 8242, Sonata, Sonnet, Fisht, Flagman, Khazar, Southerner, Yuzhny
			2	Partially vitreous	Partially vitreous varieties
			3	Milk glass in cut stearin-like without mealy or vitreous blotches	Glutinous varieties: Viola *, Violetta

* The groats obtained from "Viola" glutinous rice, as well as from foreign glutinous rice varieties, are snow-white and dull and, unlike medium and long-grain rice, are non-glassy. The grains become transparent only after heat treatment. They remain quite elastic, but are covered with a sticky substance on the outside. In Southeast Asia, glutinous rice is often used for making sweet dishes and is sometimes referred to as "sweet" [3].

In accordance with GOST R 552892012 [45], depending on the length to width ratio of the original unhulled grain and grain consistency, rice is subdivided into types and subtypes (Table 2).

Depending on the quality of the grain, rice is divided into 4 classes, in accordance with the requirements specified in table. 3 (according to [45]).

In January 2017, the Interstate Rice Standard [46] came into force, which applies to husked, ground, parboiled and uncooked rice intended for human consumption, and establishes technical requirements for cereal rice grains (*Oryza sativa* L.).

Four classes of rice (according to [45])

Table 3

Indicator name	Class norm			
	higher	the first	second	third
Typical composition	I, II, III	I, II, III	I, II, III	I, II, III
Colour	Peculiar to normal grain of rice			
Smell	Typical of normal grain rice, without musty, malty, moldy, foreign			
State	Unheated, healthy			
Yellowed grains, % , no more	Not allowed	0.3	1.5	4.0
Red grains, % , no more	2.0	5.0	10.0	15.0
Glutinous grains for types I, II, III:				
1st and 2nd subtypes, % , no more	0.3	0.5	1.0	1.0
3rd subtype, % , not less	99.0	95.0	90.0	85.0
Moisture content, %:				
no more	15.0	15.0	15.0	15.0
not less	13.0	13.0	13.0	13.0
Weed admixture, % , no more including:	1.0	1.0	1.5	2.0
millet (kurmak, suluf)	0.5	0.5	1.0	1.5
mineral admixture	0.2	0.2	0.2	0.5
spoiled rice	Not allowed	Not allowed	0.2	0.5
Grain impurity, % , no more including:	3.0	3.0	5.0	7.0
sprouted grains	Not allowed	0.5	1.0	1.5
husked grains	1.5	1.5	2.0	3.0
unripe, puny, chalky grains	1.5	2.0	3.0	4.0
Pest infestation	Not allowed	Not allowed	Not allowed except tick infestation is not above I degree	
Contamination by dead insects - pests, ind./kg, no more	Not allowed	Not allowed	15	15
Acidity, degrees, no more *	2.0	2.0	-	-

* The indicator is determined in the grain of rice grown in the fields without the use of pesticides and intended for the production of baby food.

The standard does not apply to foods derived from rice and waxy (glutinous) rice. GOST ISO 73012013 clearly defines the terminology for different types of rice grains. In particular, this regulatory document contains the following terms [46]:

Whole rice (paddy): rice (paddy, unpeeled), rice that retains the husk after threshing.

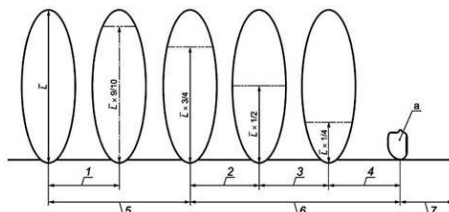
Hulled rice (husked rice): husked rice. Unhulled rice from which the husk has been removed. Note: some of the husk can be removed during peeling and other processing.

Polished rice (milled rice): White rice. Rice, from which almost all husks and germs have been removed by grinding.

Unpolished rice (undermilled rice): Rice obtained by grinding hulled rice, but not to the extent necessary to match highly minced rice.

Rice of the highest degree of grinding (wellmilled rice: rice obtained from the grinding of husked rice, from which most of the husk and germ particles have been removed. Extra class rice (extrawellmilled rice: Milled rice obtained by grinding hulled rice, from which almost all husk and germ particles have been removed. Parboiled rice (parboiled rice): hulled or polished rice made from unhulled or hulled rice that has been soaked in water and cooked so that the starch is completely gelatinized and dried.

Waxy rice (waxy rice): Glutinous rice. Rice varieties in which the grain has a white and matte appearance. Note: Waxy rice starch is composed almost entirely of amylopectin. The beans tend to stick to each other after boiling.



Rice. 1. The size of grains, broken grains and the smallest particles of rice grain by [45]: 1 - whole grains; 2- large broken grain of rice; 3- medium beaten grain of rice; 4- small broken grain of rice; 5 - rice groats; 6- broken grain; 7- the smallest particles of rice grain; a - grains that do not pass through a laboratory sieve with holes of 1.4 mm in diameter.

Whole grain (whole kernel: a hulled or polished grain of rice that does not contain broken fragments or portions of grain longer than or equal to 9/10 of the average length of the whole grain (Fig. 1).

Large broken grain of rice (large broken kernel): grain particles less than three-quarters long but more than half the average length of a whole grain (Figure 1).

Medium beaten grain of rice (medium broken kernel): grain particles less than or equal to half in length but exceeding one quarter of the average length of a whole grain (Figure 1).

Small broken grain of rice (small broken kernel): grain particles less than or equal to one quarter of the average length of the whole grain, but which do not pass through a laboratory sieve with round holes having a diameter of 1.4 mm (Fig. 1).

The smallest particles of rice grain (chaff) (chip): grain particles that pass through a laboratory sieve with round holes with a diameter of 1.4 mm. Average length (average length): The arithmetic mean of the length of grains that are not immature or misshapen and do not contain broken parts. Rice groats (A head rice is a whole grain or fragments of grains that are longer than or equal to three quarters of the average length of a whole grain [46]. The limits of physical characteristics of different types of grain are also standardized by GOST ISO 73012013 [46].

Rice groats are subdivided according to [27] into types and varieties (Table 4).

Polished rice groats of the highest and first grades, used for the production of baby food, are produced from rice grown in the fields without the use of pesticides and meeting the requirements of GOST 629390 [47].

Types and varieties of rice (according to [27])

Table 4

Type of cereal	Cereal variety	Characteristics of cereals and method of processing
Rice polished	Extra	The product obtained by grinding hulled rice grains of I or II type and consisting of kernels with a rough surface, from which flower films, fruit and seed membranes, most of the aleurone layer and embryo are completely removed
	Higher First Second Third	A product obtained by grinding hulled rice grains of type III or IV, consisting of kernels with a rough surface, from which flower films, fruit and seed coats, most of the aleurone layer and embryo have been removed, and having a content of colored kernels that does not exceed the norms established by this data standard. And also a product obtained by grinding hulled rice grains of I or II type, which did not pass in quality as an Extra grade
	Crushed rice, polished	It is not divided into varieties
		A product of rice processing into cereals, consisting of chopped, additionally polished rice kernels of I, II, III, IV types, less than a whole kernel, not passing through a sieve with holes with a diameter of 1.5 mm

3. The chemical composition of rice grain

The chemical composition of rice grain changes significantly as it is processed, described in the previous section.

Brown rice, or ricethe raw material, which has passed only through the peeling stage, retains its bran shell, which contains most of all nutrients accumulated in rice grains: vitamins - PP, thiamine and riboflavin (Table 5), carotene, folic acid; amino acids (tryptophan, methionine, choline, lecithin, lysine, histidine, cystine, arginine) (Table 6); minerals (Table 7); fiber (Table 9) [13].

Table 5

Vitamin composition (B vitamins) of brown and polished (white) rice in comparison with some other cereals (mg, per 100 g of dry cereals) (according to [21, 23, 75])

Vitamins group B	Brown rice	Sanded rice	Wild rice	Oat groats whole grain	Winter wheat	Corn
Thiamine	0.34	0.07	0.45	0.60	0.52	0.37
Riboflavin	0.05	0.03	0.63	0.14	0.12	0.12
Niacin	4.70	1.60	6.20	1.00	4.30	2.20

Table 6

The composition of essential amino acids in the grain of brown rice and some other cereals (g, per 100 g of protein) (according to [21, 23, 75])

Amino acids	Brown rice	Wild rice	Corn	Solid wheat	Oatmeal groats	Need human
Lysine	3.9	4.5	2.5	2.6	4.1	5.8
Methionine	2.1	2.8	1.8	1.5	2.2	2.5
Tryptophan	1.5	1.6	0.9	1.2	1.6	1.1
Threonine	3.7	3.4	3.8	2.8	3.4	3.4
Phenylalanine	5.0	5.1	5.0	4.7	5.5	6.3
Histidine	2.6	2.8	2.4	2.2	2.3	1.9
Isoleucine	4.0	4.4	3.9	3.7	4.0	2.8
Leucine	8.3	7.4	11.4	6.7	7.7	6.6
Valine	5.9	5.9	4.7	4.5	5.6	3.5

Table 7

Mineral composition of brown rice grain in comparison with some other cereals (mg, per 100 g of dry cereals) (according to [21, 23, 75])

Macro and trace elements	Brown rice	Sanded White rice	Wild rice	Oat groats whole grain	Winter wheat	Corn
Calcium	32	24	17-22	53	46	22
Iron	1.6	0.8	4.2	4.5	3.4	2.1
Magnesium		28	80-161	144	160	147
Potassium	214	92	55-344	352	370	284
Phosphorus	221	94	298-400	405	354	268
Zinc		1.3	3.3-6.5	3.4	3.4	2.1

In addition to vitamins and other listed micronutrients, rice bran contains dietary fiber, valuable vegetable fats and proteins, which are lost during further processing of brown rice in order to obtain white grains [40].

Table 8 shows the typical macronutrient composition of brown rice in comparison with some other cereals (g, per 100 g dry cereals) [21, 23, 75].

Table 8

Typical macronutrient composition of brown rice in comparison with some other cereals (g, per 100 g dry cereal) [21, 23, 75]

	Brown rice	Wild rice	Corn	Durum wheat	Oat groats
Starch	78.0	74.0	71.5	66.5	62.0
Protein	8.7	13.5	9.0	14.5	15.5
Dietary fiber	5.3	6.8	9.5	11.5	11.0
Sahara	1.3	1.7	2.3	1.7	1.4
Oils and fats	2.6	0.8	4.7	1.8	6.5
Ash	1.5	1.8	1.5	2.0	2.0

A grain of brown rice is characterized by a higher content of the entire spectrum of biologically active substances than white rice, including hemicellulose and lignans with antioxidant and anti-inflammatory properties, which, according to modern scientific data, can bring significantly greater health benefits than white rice [73].

White rice is obtained from brown hulled rice in the next processing step after hulling - grinding. In this case, the chemical composition changes significantly: the protein content decreases by 1.0-1.5%, the fat content by 1.0-1.5%, the fiber content by 1.5-2 times, the starch content increases by 2-4% [13]. At this stage of processing, cereals are deprived not only of adherent films, but also of an embryo with an aleurone layer, rich in vitamin B₁ [26], which naturally affects the biological properties of rice.

After grinding and subsequent polishing of rice, only white smooth grain remains from the original unbroken grains, containing up to 70% starch [13], up to 75% carbohydrates in general (according to other data, 70-80% [9, 18, 19, 40]), and only 2.2% fiber [26]. It is white rice that today has the main food value in the world and is called rice groats [26].

In addition to carbohydrates, such a grain of rice (rice groats) still contains a relatively large amount of protein (up to 12%) (Table 9), which is close in composition to animal protein [18, 40, 51] (according to other data - 7.7% [26]), and fat (up to 4%), with a minimum content of vitamins [9, 18, 19, 51]. Despite the fact that peeled rice is significantly poorer in protein than unpeeled (brown) [18, 23, 51], rice protein has good nutritional qualities and contains essential amino acids (valine, lysine, methionine, etc.) [9, 18, 19, 23].

Grain of white rice (rice cereal) also contains free amino acids; vitamins - mainly of group B (B₁, V₂, V₆, pantothenic acid), E, biotin (vitamin H), F; minerals: potassium, iron, etc. [9, 18, 19, 23], phosphorus salts [23, 40] (rice ash is rich in phosphoric acid [23, 43]), melatonin [23, 40]. Refined rice is significantly poorer in B vitamins and minerals than brown rice [19, 23, 51]. The chemical composition of some types of white rice in comparison with other cereals is presented in table. nine.

When cleaning rice grains from the remaining fruit and seed coats and part of the endosperm, a special flour is obtained, which is very rich in protein - up to 14%, fats - up to 15%, organophosphorus compounds and vitamins [26]. It serves as a raw material for phytin production in the pharmaceutical industry and as a good complementary feed for farm animals [26].

Parboiled rice has its advantages: when steaming under pressure up to 80% of the vitamins and minerals contained in the bran shell passes into the grain of rice, and the grains themselves become less brittle [13].

Chemical composition of 100 g (per serving) of different types of white rice compared to some grains and pulses
(according to [59, 60] * and [39] **), USA [74] ** // % of the recommended consumption rate (RNP) in the Russian Federation [33, 34]

Product (title cereals /cereals)	Water	Squirrels	Fats	Carbohydrates			Food fiber	Minerals						Vitamins					
				General	Mono and di saccharides	Starch		Na	K	Ca	Mg	P	Fe	Carotene	Retin. eq.	Tocopherol. eq.	V1 - thiamine	V2 - ribo flavin	PP - niacin, V3
Norms fiziol. need. (RF) [33, 34]								1300	2500	1000	400	800	ten (M) mg (F)	5.0	900	15	1.5	1.8	
Unit measurements	Grams // % of RNP							mg	mg	mg	mg	mg	mg	mcg	mcg	mg	mg	mg	mg
Cereals																			
Groats rice *	14.0	7.0 // 10.8% M 12.1% F	1.0 // 1.4% M 1.7% F	74.0 // 28.8%	0.7	72.9	3.0 // 15.0%	12.0 // 0.9 %	100.0 // 4.0 %	8.0 // 0.8 %	50.0 // 12.5 %	150.0 // 18.8 %	1.0 // 10.0 % M 5.6 % F	0	0	0,4 // 2.7%	0.08 // 5.3%	0.04 // 2.0%	1.6 // 8.0%
Rice round grain (raw) **	13.3	6.50 // 10.0% M 11.2% F	0.52 // 0.7% M 0.9% F	79.15 // 30.8%	-	-	-	1.0 // 0.1 %	76.0 // 3.0 %	3.0 // 0.3 %	23.0 // 5.8 %	95.0 // 11.9 %	0.8 // 8.0 % M 4.4 % F	-	-	-	0.07 // 4.7%	0.05 // 2.8%	1.6 // 8.0%
Rice long-grain (raw) **	11.6	7.13 // 11.0% M 12.3% F	0.66 // 0.9% M 1.1% F	79.95 // 31.1%	0.12	-	1.3 // 6.5%	5.0 // 0.4 %	115.0 // 4.6 %	28.0 // 2.8 %	25.0 // 6.3 %	115.0 // 14.4 %	0.8 // 8.0 % M 4.4 % F	0	-	Vit E 0.1 // 0.7%	0.07 // 4.7%	0.05 // 2.8%	1.6 // 8.0%
Wild rice**	7.76	14.73 // 22.7% M 25.4% F	1.08 // 1.5% M 1.8% F	74.9 // 29.2%	2.5	-	6.2 // 31.0%	7.0 // 0.5 %	427.0 // 17.1 %	21.0 // 2.1 %	177.0 // 44.3 %	433.0 // 54.1 %	1.96 // 19.6 % M 10.9 % F	-	19.0 // 2.0%	Vit E 0.8 // 5.5%	0.115 // 7.7%	0.262 // 14.6%	6.73 // 33.7%
Groats buckwheat brown *	14.0	12.6 // 19.4% M 21.7% F	3.3 // 4.7% M 5.5% M	57.6 // 22.4%	1.4	55.4	11.3 // 56.5%	3.0 // 0.2%	380.0 // 15.2 %	20.0 // 2.0 %	200.0 // 50.0 %	298.0 // 37.3%	6.7 // 67.0 % M 37.2 % F	10.0 // 0.2%	2.0 // 0.2%	0.8 // 5.3%	0.43 // 28.7%	0.2 // 11.1%	4.2 // 21.0%
Buckwheat cereal after heat treatment ki **	8.41	11.73 // 18.0% M 20.2% F	2.71 // 3.8% M 4.5% F	74.95 // 29.1%	-	-	10.3 // 51.5%	11.0 // 0.9%	320.0 // 12.8 %	17.0 // 1.7 %	221.0 // 55.3 %	319.0 // 39.9 %	2.47 // 24.7 % M 13.7 % F	-	-	-	0.22 // 14.9%	0.271 // 15.1%	5.14 // 25.7%
Buckwheat groats new green (corn buckwheat foodstuff venous *)	14.0	10.8 // 16.6% M 18.6% F	3.2 // 4.6% M 5.3% F	56.0 // 21.8%	1.5	54.1	14.0 // 70.0%	4 // 0.3 %	325 // 13.0 %	70 // 7.0 %	258 // 64.5 %	334.0 // 41.8 %	8.3 // 83.0 % M 46.1 % F	10.0 // 0.2%	2.0 // 0.2%	0.8 // 5.3%	0.3 // 20.0%	0.14 // 10.0%	3.9 // 19.5%
Buckwheat groats new without thermo processing **	9.75	13.25 // 20.4% M 22.8% F	3.4 // 4.9% M 5.7% F	71.5 // 27.8%	-	-	10.0 // 50.0%	1 // 0.1 %	460 // 18.4 %	231 // 1.8 %	347.0 // 57.8 %	2.2 // 22.0 % M 12.2 % F	-	-	-	0.1 // 6.7%	0.425 // 23.6%	7.02 // 35.1%	
Pearl barley cereal *	14.0	9.3 // 14.3% M 16.0% F	1.1 // 1.6% M 1.8% F	66.9 // 26.0%	0.9	65.7	7.8 // 39.0%	ten // 0.8 %	172 // 6.9 %	38 // 3.8 %	40 // 10.0 %	323.0 // 40.4 %	1.8 // 18.0 % M 10.0 % F	0	0	1.1 // 7.3%	0.12 // 8.0%	0.06 // 3.3%	2.0 // 10.0%
Barley cereal *	14.0	10.0 // 15.4% M 17.2% F	1.3 // 1.9% M 2.2% F	65.4 // 25.5%	1.1	63.8	8.1 // 40.5%	15 // 1.2 %	205 // 8.2 %	80 // 8.0 %	50 // 12.5 %	343.0 // 42.9 %	1.8 // 18.0 % M 10.0 % F	0	0	1.5 // 10.0%	0.27 // 18.0%	0.08 // 4.4%	2.7 // 13.5%
Corn cereal *	14.0	8.3 // 12.8% M 14.3% F	1.2 // 1.7% M 3.7% F	71.0 // 27.6%	1,2	69.6	4.8 // 24.0%	7 // 0.5 %	147 // 5.9 %	ten // 2.0 %	ten // 7.5 %	109.0 // 13.6 %	2.7 // 27.0 % M 15.0 % F	200.0 // 4.0%	33.0 // 3.7%	0.7 // 4.7%	0.13 // 8.7%	0.07 // 3.9%	1.1 // 5.5%
Semolina *	14.0	10.3 // 15.8% M 17.8% F	1.0 // 1.4% M 1.7% F	70.6 // 27.5%	1.6	68.5	3.6 // 18.0%	3 // 0.2 %	130 // 5.2 %	ten // 2.0 %	ten // 4.5 %	85.0 // 10.6 %	1.0 // 10.0 % M 5.6 % F	0	0	1.5 // 10.0%	0.14 // 9.3%	0.04 // 2.2%	1.2 // 6.0%
Groats wheat ("Poltavskaya") *	14.0	11.5 // 17.7% M 19.8% F	1.3 // 1.9% M 2.2% F	67.9 // 26.4%	2.0	66.5	4.4 // 20.0%	17.0 // 1.3 %	230.0 // 9.2 %	40 // 4.0 %	60 // 15.0 %	261.0 // 32.6 %	4.4 // 44.0 % M 24.4 % F	0	0	1.8 // 12.0%	0.3 // 20.0%	0.1 // 5.6%	1.4 // 7.0%
Legumes																			
Chickpea, Turkish peas***	12.3	29.6 // 45.5% M	1.2 // 1.7% M	53.7 // //	Glucose 8.45	33.8	Kletch 3.65 // 18.3%	56 // //	659 // //	84.2 // //	42 // //	126.0 // //	12.1 // //	0.03 // //	-	-	0.5 // //	0.21 // //	1.8 // //

		M 51.0% F	2.0% F	20.9%				4.3 %	26.4 %	8.4 %	10.5 %	15.8 %	121.0 % M 67.2 % F	0.001			33.3%	11.7%	9.0%
Peas shelled *	14.0	23.0 // 35.4% M 39.7% F	1.6 // 2.3% M 2.7% F	48.1 // 18.7%	3.4	44.7	10.7 // 53.5%	27 // 2.1 %	731 // 29.2 %	89 // 8.9 %	88 // 22.0 %	226.0 // 28.3 %	7.0 // 70.0 % M 38.9 % F	10.0 // 0.2%	2.0 // 0.2%	0.5 // 3.3%	0.90 // 60.0%	0.18 // 10.0%	2.4 // 12.0%
Beans *	14.0	21.0 // 32.3% M 36.2% F	2.0 // 2.9% M 3.3% F	47.0 // 18.3%	3.2	43.8	12.4 // 62.0%	40 // 3.1%	1100 // 44.0 %	150 // 15.0 %	103 // 25.8 %	480.0 // 60.0 %	5.9 // 59.0 % M 32.8 % F	0	0	0.6 // 4.0%	0.50 // 33.3	0.18 // 10.0%	2.1 // 10.5%
Lentils*	14.0	24.0 // 36.9% M 41.4% F	1.5 // 2.1% M 2.5% F	46.3 // 18.0%	2.9	43.4	11.5 // 57.5%	55 // 4.2%	672 // 26.9 %	83 // 8.3%	80 // 20.0 %	390.0 // 48.8 %	11.8 // 118.0 % M 65.6 % F	very // 0.6%	5.0 // 0.6%	0.5 // 3.3%	0.50 // 33.3	0.21 // 11.7%	1.8 // 9.0%

Notes:

1. Retinol equivalent (ER). Takes into account the amount of retinol in the product and retinol formed in the body from beta-carotene (1 µg of retinol is equivalent to 6 µg of beta-carotene and 12 µg of other carotenoids).

2. Vitamin E equivalent (tocopherol equivalent) (TE). It takes into account the entire group of tocopherol compounds (4 tocopherols and 4 tocotrienols), united by the common name "vitamin E". To obtain this indicator, the following conversion factors are used: alpha tocopherol - 1.0, betatocopherol - 0.4, gammatocopherol - 0.1, deltatocopherol - 0.01, alpha tocotrienol - 0.3, betatocotrienol - 0.05, gamma and deltatocotrienols - 0.01 [61]

4. Biological action, features of medico-pharmaceutical and dietary use of rice

4.1. Modern official medico-pharmaceutical practice

High quality starch is obtained from rice grain, which is used in the pharmaceutical industry as a filler in the manufacture of tablets and dragees [18, 19].

4.2. Food use of various varieties and types of rice

In Russia, many different dishes are traditionally prepared from processed rice grains (rice groats), often with the addition of spices and herbs: porridge, pilaf, casseroles, soups, etc. In the East, rice is an indispensable attribute of every day of life, often every meal [4, 9, 18, 19, 23, 41].

Recently, a large number of dishes from various national cuisines of the world have appeared in the diet of the inhabitants of our country, one of the most common ingredients of which is rice of strictly defined varieties, which are almost in full range on the food market of the Russian Federation [18, 51].

The world's rice king is considered the most expensive Basmati variety (the Indian is valued, the Pakistani is a little less valuable). The Arborio variety is native to Italy and is known there as risotto. The round grain Valencia, or Paella, is similar to it, from which, according to experts, the most delicious seafood paella is obtained. The Jasmine variety has a special delicate aroma and is often called Asian rice because it is grown in Vietnam, Thailand and other countries of Southeast Asia. The Kamolino variety has been cultivated in Egypt since ancient times. The Devzira variety grows in the Fergana Valley and is considered ideal for making Uzbek pilaf.

The taste and preservation of the finished dish depend on many factors, in particular on the nature of the original cereal: the more processed the grain, the less vitamins and minerals it contains, but the longer the shelf life of the cereal itself and dishes made from it can be. In general, long-grain varieties of white rice (Table 1) are elastic and crumbly, therefore they are used for making snacks, salads, side dishes, soups. Risotto, paella, and porridge are prepared from medium-grain varieties (Table 1). Round grain varieties boil well and stick together, so they are used to prepare sushi, casseroles, pies, cereals, puddings, desserts [18].

Brown rice is more expensive than white rice because it is less in demand and has a relatively short shelf life from due to the fact that an oil-containing shell remains on the grains [13, 23]. Its cooking time increases in comparison with white rice by an average of 25 minutes, and ready-made brown rice is much less soft than white rice [13].

In Europe and America, brown rice is especially appreciated by supporters and adherents of a healthy lifestyle due to the higher content of nutrients compared to regular white rice [13, 18, 69]. Modern food technologists also proceed from the fact that white rice groats are characterized by a higher starch content with a lower amount of protein (complete in amino acid composition), since during the grinding process vitamins and minerals are almost completely separated from the rice grain along with flower films, fruit and seed coats. substance, and hence the nutritional value of cereals decreases [23, 69].

After the grinding stage, the nutritional value of rice decreases, but the culinary advantages of rice groats increase: it acquires a beautiful appearance, a smooth and shiny (after polishing) surface, water absorption capacity and boil-up ratio increase, the cooking time is reduced, and the structure of the cooked porridge improves [13].

Despite the fact that white rice is inferior to brown and parboiled rice in terms of the content of vitamins and minerals, it is he who is the main type of rice consumed all over the world [13]. This is largely due to the possibility of its long-term storage, which acquires strategic importance in the event of lean years and food shortages [18, 23].

Parboiled rice has a yellowish tinge that disappears when cooked and becomes as white as milled rice. The cooking time is increasing compared to white, up to 20–25 minutes due to the fact that the grains become harder during processing and boil more slowly than ordinary rice. After boiling, parboiled rice does not stick together and does not lose its taste after reheating the dish [13].

All types of rice require prior rinsing and soaking in cold water from 2 (white rice) to 10–12 hours (brown rice) [2].

4.3. Experience of traditional (folk) medicine

In domestic traditional medicine, slimy rice broth is used in diseases of the upper respiratory tract as an emollient and anti-inflammatory agent [4, 18, 19, 23].

In the people and in the domestic traditional medical practice, rice is considered a food product that cleanses the body (detoxifying effect) and normalizes metabolism. Known traditional methods of treating gout, osteochondrosis, arthritis, rheumatism with a diet based on the use of unpolished rice for cooking [9, 18, 19, 23].

In traditional Chinese medicine (TCM), sowing rice has historically been used to prepare the liquid medicinal zhou porridge, which was prepared in southern China by boiling in large quantities of water, usually with the addition of medicines or other foods that also have medicinal properties (in northern China). In China, such porridge was traditionally made from chumiza or millet). This kind of porridge has always been considered extremely useful. She was fed to young children, cooked at the slightest ailment, and ate it for breakfast in order to prevent the weakening of vitality [3].

Modern Chinese rice (粳米 - jǐng - jǐng) is regarded as an everyday food product that has never been endowed with special healing properties. However, in traditional dietics still recommend it for lack of Spleen and Stomach Qi (weight loss, decreased appetite, weakness, fatigue, sweating, diarrhea, vomiting). Indications for use are also damage to the Yin of the stomach by heat (dry mouth, thirst) and diarrhea [3, 23]. Modern "Western" experts in the use of TCM experience proceed from the fact that sowing rice replenishes the Spleen (heals the emptiness of the Spleen) and Qi, harmonizes the Stomach, benefits the semen and strengthens the will, is used in the treatment of diabetes, diarrhea, dysentery, exhaustion, and kidney emptiness, and a melancholy suppressed mood, eliminates anxiety and thirst [3, 14, 15, 22, 23, 30, 52, 54].

In accordance with the theoretical concepts of TCM, rice cereal has a sweet (replenishing) taste, neutral properties [3, 23], according to other sources - a sweet taste and restraining character [23, 70]. Corresponds to the channels of the Spleen and Stomach [3, 23].

Rice cereals perform the following functions: replenishing the Spleen and Stomach, strengthening the Spleen, bringing the Stomach to harmony, eliminating thirst, stopping diarrhea, strengthening bones and tendons. Grits are used internally, 50–200 g in the form of liquid cereals, in broths, after frying, and also in the form of flour dissolved in water. It is not recommended to use fried rice groats and rice flour in case of internal heat syndrome [3, 23].

In medical publications of the 7th century (Shi liao ben cao - Roots and herbs for medicinal nutrition) and 1590 (Ben cao gan mu - Systematization of the description of roots and herbs), it is noted that rice grown in the north has the properties of coolness, in the south - heat properties. Rice of the old harvest has the properties of coolness, the new harvest - the properties of heat. Rice of the new harvest is able to activate pathogenic Qi, and for a whole year it retains the ability to provoke the appearance of a lingering disease [Cit. according to: 3].

Fresh rice has the properties of cold, after frying - the properties of heat. If rice cereal has the properties of cold, then it is not recommended to eat it in large quantities, since it activates the Qi of the wind and creates obstacles to the circulation of Qi in all channels and collaterals, which causes weakness in the limbs and drowsiness. But white rice, harvested at a later date and having the properties of cold, can be used for treatment with appropriate indications [Cit. according to: 3].

Short-grain rice (grain) - 粳米 jǐngmǐ (common name: 大米 - damǐ) has a character of impact and taste: smooth, warm, sweet. Action: replenishes the middle (replenishes the middle heater), promotes the accumulation (enriches) Qi, strengthens the Spleen, nurtures (nourishes) the Stomach. It is recommended for general decline in vitality, fever and high temperature, prolonged illness, for recuperation after childbirth, as well as for the elderly. Rice porridge is especially useful in spring. Contraindications: none [22, 23, 30, 54].

Glutinous rice - 糯米 nuómǐ, common name: 元米 yuánmǐ, 江米 jiāngmǐ - Jiangnan glutinous rice. Impact and taste: warming, warm, sweet, bitter. Corresponds to the channels of the Spleen, Stomach, Lungs. Action: replenishes the Middle (replenishes the middle heater), promotes the accumulation (enriches, promotes the accumulation) of Qi, strengthens the Spleen, replenishing its energy, nourishes (nourishes) the Stomach, stops devastating (caused by emptiness) sweat (reduces perspiration), dissipates toxin, helps to reduce frequency of urination. Refers to products that replenish energy. Recommended for diabetes, increased urination, unmotivated sweating, diarrhea [3, 22, 23].

In classical TCM, based on historical sources, indications for use are [3]:

- Qi deficiency; sweating and shortness of breath, aggravated by physical exertion, frequent urination, loose stools, diarrhea, loss of appetite, back pain, weakness, fatigue, pallor, light tongue;
- increased fetal motor activity in pregnant women;
- purulent inflammation of the skin and subcutaneous tissue.

Application and dosage: inside, 50–100 g as part of liquid cereals, in decoctions, pills and powders; outwardly - boiled or in the form of flour [3].

Contraindications: increased phlegm fire caused by the penetration of heat and dampness; heat; cough with yellow sputum; jaundice, bloating. It is also used with caution for constipation and phlegmyzhar syndrome. It is not recommended to consume in large quantities [3]. Glutinous rice is sticky in nature and therefore makes it difficult to digest and digest food. It is not recommended for old people, children, people with weakened digestion and those recovering from an illness to eat cakes, cookies, sweets and glutinous rice pancakes [3, 22, 23].

Brown rice - 谷芽 gǔyá, common name: 稻芽 dàoyá - brown rice. Impact and taste: warming, warm, sweet. Action: strengthens spleen, opens the stomach, stimulates appetite, harmonizes the center (calms and harmonizes the middle heater), eliminates congestion and congestion, promotes digestion and assimilation of food.

Contraindications: none [22, 23].

Special Notes: For proper use, must simmer until gummy. For medicinal purposes, poria or dereza fruits are added to enhance the nourishing properties [70].

Rice chaff, chaff - chaff (bra 米皮糠 mǐpíkāng, common name: 苡糠 yǐkāng - rice chaff, chaff (bran, small seeds), 细糠 xìkāng - rice chaff, small sowings), 米糠 mǐkāng - rice chaff, chaff. Impact and taste: harmonizing, even, tart (bitter) and sweet. Action: provides intestinal permeability, opens the stomach, stimulates (increases) appetite, promotes lowering of Qi (promotes the release of gases from the intestines), eliminates Qi stagnation, dissolves (relieves) stagnation and blockages - dissolves food accumulation, improves intestinal permeability. Contains a lot of provitamin A

(carotenoids), B vitamins.

Contraindications: none [22, 23].

To facilitate dietary prescriptions B. Temeli and B. Trebut (2010) summarized in one table (Table 10) the most commonly used cereals by Europeans, indicating their properties in accordance with the System of Five Elements, which is one of the main theoretical foundations of TCM [54].

R. Dalke (2010) proposed a similar classification by thermal properties, taking into account the traditional "taste", and taking into account the way in which cereals are usually prepared - whether they are eaten raw or boiled, baked in the oven or fried before cooking (Table 11) [ten].

In Ayurveda, white rice, especially basmati rice, is the most commonly consumed crop [28, 49].

Table 10

Correspondence of cereals and cereals to the System of Five Elements (according to [54])

Element	Taste	Directions <small>Indolence</small>	Action	Sorrow <small>chiy</small>	Warm	Neutral <small>ny</small>	Refreshing <small>shy</small>	Cold
Wood	Sour	Inside and <small>may down</small>	Preserves juices	-	Spelled	Bulgur, couscous, spelled	Wheat	Bran wheaten ny, sprouts wheat
Fire	bitter	Way down	Encourages To change	-		Amaranth, quinoa, rye	Buckwheat	
Earth	Sweet	Distribution in <small>everyone on right niyah</small>	Nourishes and moisturizes	-	Rice sweet (special kind of rice)	Corn in on the cob, millet	Barley	
Metal	Spicy	Up and outside	Shifts and eliminates <small>stagnation</small>	-	Oats	Rice		
Water	Salty	Directed in depth	Strengthens bones and eliminates <small>stagnation</small>	-	-	-	-	-

Table 11

Thermal classification of cereals
taking into account the traditional European cooking method (according to [10])

Thermal (thermal) properties	The nature of the impact on the body	Grain name culture or cereals
Hot	- Protect from cold, especially in winter; - Activate the body's defenses; - Activate digestion; - Must be consumed in limited quantities to avoid intense internal heat.	
Warm	- Warm the body and give strength; - Best suited for autumn and winter, especially in combination with neutral; - In the summer it is better to keep consumption to a minimum.	Amaranth Green grain Oats Spelled Waxy rice, or gummy
Neutral	- Provide a balancing effect; - Saturates well, helps to keep the middle and provide energy; - Should form the basis of nutrition practically each person; - Almost all cereals are boiled are of this type.	Buckwheat Quinoa (quinoya) Corn Flax-seed Millet Rice Basmati Round grain rice Rye
Refreshing (cool)	- Improves hematopoiesis and the production of other body fluids; - Promote moisturizing of mucous membranes and other tissues; - More suitable for the warm season, but useful all year round (their consumption should be limited only in winter).	Wheat Barley groats - barley, pearl barley
Cold	- May lead to an energy imbalance in the body; - May slow down the absorption of biologically active substances from other products; - May increase the secretion and accumulation of mucus; - More suitable for warm seasons and should be kept to a minimum in winter.	Cereals Wheat flakes Wheat bran

White rice in Ayurveda is considered a sweet and cooling cereal, which after digestion has a sweet effect and is easy to digest. Rice gives hard stools, balances Pitta and can slightly stimulate Vata [49]. According to other sources, rice is especially beneficial for Vata and Pitta, but Kapha is suitable only with moderate consumption [28] (Tables 12, 13).

Table 12

Compatibility of rice and other grains with the main constitutional types
in Ayurveda (according to [28, 29])

WATA		PITTA		Kapha	
NO	YES	NO	YES	NO	YES
	Amaranth*		Amaranth		Amaranth*
	Pancakes, pancakes		Pancakes, pancakes	Pancakes, pancakes	
Granola			Granola		Granola
Buckwheat		Buckwheat			Buckwheat
			Breakfast bread cereal, dry		
	Quinoa, quinoa (quinoa)	Quinoa, quinoa (quinoa)			Quinoa, quinoa (quinoa)*
Crackers			Crackers		Crackers
Corn		Corn			Corn
Couscous			Couscous		Couscous
Pasta**			Pasta	Pasta**	
Muesli		Muesli **			Muesli
Oats (dry)	Oats concep lazy	Oats (dry)	Oats cooked	Oats prigo cooked	Oats (dry)
Oat bran			Oat bran		Oat bran
Spelled			Spelled		Spelled *
Polenta (porridge from corn) **		Polenta (porridge from corn) **			Polenta (porridge from corn)
Millet		Millet			Millet
	Wheat		Wheat	Wheat	
	Wheat flour durum		Wheat flour durum		Wheat durum flour *
Wheat bran			Wheat bran		Wheat bran
	All kinds of rice	Rice Brown	Rice (basmati, white, wild)	Rice (brown nevy, White)	Rice (basmaty, wild) *
Rice tortillas **				Rice tortillas **	
Rye		Rye			Rye
Sago					
Tapioca			Tapioca		Tapioca
	Prophet bread puppy dog prostrate (bread Essenes)	Bread yeast	Prophet bread puppy wheat (bread Essenes)		Bread from germinated wheat (Essenes bread)
Bread or cereals breakfasts (cold, dry, in the form flakes)					
Bread yeast				Bread yeast	
Barley			Barley		Barley

Note. The recommendations are general in nature. Individual adjustments may be required, taking into account the possibility of allergic reactions, the strength of digestion, the season, the degree of prevalence of the dominant dosha and the current state of the body. If a product is not listed in the table, follow the general guidelines for this type of product.

* Allowed to be consumed in moderation
** Use is allowed occasionally

Table 13

Properties and nature of the influence of cereals and cereals on the doshas (according to [28])

Product	Taste	Action	Influence on doshas		
			Cotton wood	Pitta	Kapha
Amaranth	Sweet, astringent	Lung	↓	↓	↓
Flour pancakes wheat	Sweet	Heavy, oily	↓	↓	↑
Buckwheat	Astringent	Heavy	↑	↑	↓
Quinoa, quinoa	Sweet	Warming, grounding	↓	↑	↓ (1)
Corn	Sweet	Dry, light	↑	↑	↓
Pasta	Astringent	Heavy, soft	↑	↓	↑
Raw oats	Sweet	Heavy	↑	↑	↓
Cooked oats	Sweet	Heavy	↓	↓	↑
Oat bran	Astringent, sweet	Rough, dry, light	↑	↓	↓
Spelled	Sharp, astringent	Light, dry	↑	↓	↓ (1)
Millet	Sweet	Dry, light	↑	↑	↓
Wheat	Sweet	Heavy, oily, laxative	↓	↓	↑
Wheat flour durum	Sweet, astringent	Lung	↓	↓	↑
Basmati rice	Sweet	Light, soft, beneficial	↓	↓	↓
White rice	Sweet	Soft, water-retaining	↓	↓	↑
Brown rice	Sweet	Heavy	↓	↑	↑
Rye	Astringent	Dry, light	↑	↑	↓
Sago	Astringent, sweet	Light, drying	↑	↓	↓
Barley	Sweet	Lung, diuretic	↑	↓	↓

When using cereals in the diet, one should take into account the ability of each of them to influence different doshas in the body [28, 29, 42]. Table 12 shows data on the compatibility of grain products and some products from them in accordance with the main constitutional types in Ayurveda (according to [28, 29]). These recommendations are general

character and need individualization, taking into account the strength of digestion, the season, the degree of prevalence of the dominant dosha.

In general, the effect of grain on doshas, constitution and metabolism is characterized as:

Vata, Pitta, Kapha ++, anabolic ++ [42]. In general, grains have a sweet (madhura rasa) taste and are therefore useful for maintaining a balanced state in the body. In the characterization of sweet foods, the predominant primary elements (mahabhuta) are Earth (prithivi) and Water (ap). They are characterized by the following properties: increases the tissues of the body (dhatu), life expectancy and vitality, improves complexion, cleanses the senses, softens the burning sensation [42].

Runny rice porridge is considered an excellent food for the sick, especially in case of intestinal inflammation, fever, fever, and for convalescents. In Ayurveda, rice cooked with meat, vegetables, fat, ghee, ghee, vegetable ghee, bone marrow, fruits, black beans, mung beans, milk or sesame seeds is tonic, extremely nutritious and healthy for the heart. Rice is used in the preparation of many medicines and is considered medicine in itself. For example, with heavy menstrual bleeding, rice is washed several times in water and the women are allowed to drink this water [49].

Brown rice is rarely used in Ayurvedic recipes because it is difficult to digest, increases the fever too much in Pitak people, and is too heavy for Kapha. [28]

Tibetan medicine divides all crops into two types: spike and leguminous. Rice is a spike, like millet, wheat, gymnosperm barley, wildbarley, oats and other cereals that have a "sweet" taste after being digested. In terms of their effect on the body, most of these cultures in Tibetan medicine are classified as agents that suppress passion and the Wind system, as well as generate strength and Mucus [63, 64]. In accordance with the terminology of Tibetan medicine, each cereal culture has its own character and its own thermal characteristics (Table 14).

Table 14

Warming and cooling cereals (according to [50])

Cereals	Warming	Neutral	Cooling
Buckwheat groats			+
Semolina and other wheat cereals			+
Oats, oatmeal		+	
Millet			+
Rice and rice cereals		+	
Rye and rye cereals			+
Barley, barley and pearl barley			+

The theory of Tibetan medicine assumes that the properties of cereals (like legumes) can change over time and depending on the heat treatment [50]. All freshly harvested raw grains (new harvest) are "heavy", and ripe, dry and old grains are "light". Cooked and toasted grains become "lighter", digested and absorbed better, so before cooking porridge, it is useful to fry almost any cereal a little [50, 63]. Tibetans have historically used roasted cereal grains, for example, to dress in tea to make it more nutritious. In addition, they used liquid cereal soups, which, being easily digested, gave strength and cleansed the body [63].

From the standpoint of Tibetan medicine, rice is an oily, soft, cold (cool) and light product [50, 63]. It has a beneficial effect on all three regulatory systems [50, 63], controls sexual desire, and treats vomiting and diarrhea [62]. Liquid rice soup quenches thirst well, relieves hunger, fatigue, "evens out the strength of the body, generates heat and softens the vascular cavity." The thicker soup also generates heat, "helps with fatigue, dissolves diseases, removes the retention of impurities" [63]. Rice soups in water or broth are beneficial for all constitutional types [50], but unripe rice (or barley) soup induces appetite and suppresses heat [63].

For the constitution of Mucus, a combination of rice with milk (milk porridge) is considered undesirable, so people of Mucus should steam it or in water, salt can be added, but sugar cannot be added. For people of the Wind constitution, it is useful to cook rice in milk, add butter, sugar, honey, jam. Porridge and fried rice soups improve bone healing in fractures, help with diarrhea. Rice dishes reduce blood cholesterol levels and are used to prevent atherosclerosis [50].

4.4. Modern dietetics

In dietetics, rice cereal (due to its high energy value, nutritional value and easy digestibility) is considered one of the best products not only for everyday, but also for dietary nutrition [26], and rice dishes are included in the diet of children and weakened people [18, 19, 26].

Compared to other cereals, white rice is rich in carbohydrates (the leader among cereals - up to 72.5%), but the relative poverty of protein substances - the share of the former in dry matter reaches 70%, the latter, as a rule, is no more than 12% [43]. The fat content is also low [18, 66]; therefore, rice is characterized by a relatively low calorie content [13], comparable to the calorie content of buckwheat groats [51].

The popularity of rice in dietary nutrition is associated precisely with its low calorie content, since carbohydrates are contained mainly in the form of starch, which belongs to polysaccharides, and to a lesser extent contributes to body weight gain in comparison with mono and disaccharides [13, 35]. Due to the content of significant amounts of starch (it has the ability to swell strongly when cooking cereals) with a low content of dietary fiber, rice is easily digested and well absorbed [18, 23, 66]. When cooked, rice grits swell to at least three times their original weight and therefore have a low energy density advantage over other carbohydrate foods such as bread [73].

The starch contained in rice is favorable for the functioning of the intestines, has a positive effect on the development of bifidobacteria and improves the function of the immune system [13, 35, 40]. And due to its adsorbing properties, rice absorbs harmful substances that enter the body with other types of food, and unwanted metabolic products [13, 35]. Therefore, rice groats and rice dishes are considered especially valuable food products for removing salts and unwanted metabolites from the body and for detoxification in general [13, 35, 40].

In the 60s. In the twentieth century, macrobiotic diets based on white rice came into vogue, but after a while it became clear that the abuse of such diets can cause a deficiency of certain minerals in the body. Therefore, at present they are not recommended for all patients (only for indications) and are not recommended at all for children [13].

In addition to the fact that rice is the main source of energy for the population of many regions of the planet, it is considered important in dietetics that even after purification it contains the most important vitamins: thiamine, riboflavin, niacin, vitamin E [73] and basic minerals: zinc, potassium, iron [73]. Rice is one of the leaders among cereals in terms of potassium content - 70 mg, calcium - 30 mg, phosphorus - 104 mg [13, 35].

One of the advantages of rice groats is considered to be practically the absence of sodium in its composition (if salt is not added to rice dishes [73]) with a high potassium content, which is used in diet therapy of cardiovascular diseases and in disorders of water-salt metabolism [13, 35]. The synergism of magnesium compounds with vitamin PP contained in rice (especially brown and parboiled) is also considered valuable, which makes dishes from it indispensable in the diets of neurological patients [73]. In China, rice bran is used to treat beriberi disease (hypovitaminosis B1) [18, 19, 26].

Diets based on water-boiled rice, recommended for obesity, have been described [51]. However, milk and sweet rice porridges are strongly discouraged for obesity [26]. Despite the widespread belief that starchy carbohydrate foods are classified as "weight gainers," diets containing rice have, on the other hand, been shown to achieve weight loss in obese patients. At the same time, it is noted that the greatest weight loss, in comparison with white rice, is achieved in diets on mixed types of rice (white, brown and wild) [73].

Rice grits, like semolina, are low in fiber [18, 51]. When rice is boiled, a lot of mucous broth is formed, which is used in diet therapy for diseases of the digestive system [51]. Despite the fact that rice groats do not contain tannins and have no astringent effect, but mucous decoctions from them and rice starch inhibit intestinal motility [19], therefore they are given for gastrointestinal disorders accompanied by diarrhea [18, 19, 26]. It is considered advisable to use such decoctions even with dysentery [26]. Mucous broths and cereals are used as an enveloping agent for certain diseases of the digestive system [51] and when taking irritating drugs [18, 19, 51].

The immunomodulatory, antioxidant, membrane-protective and gerontoprophylactic effects of rice are also described [40].

Rice protein is considered to be much more beneficial than proteins of wheat and other cereals [26] (buckwheat does not belong to the family of cereals). It is quite close in composition to proteins of animal origin [26,51], has good nutritional qualities and contains essential amino acids (valine, lysine, methionine) [18, 19, 26, 51].

Rice has a low allergenicity (allergic risks) and is relatively easy to digest, which makes it a useful food product in case of early weaning of infants or during the recovery period [73], however, according to domestic data, the frequency of sensitization to rice cereal in children is 15, 5% [23], that is, it is practically observed in one child out of six.

The spectrum of established types of action for bran is even wider than that of refined milled white rice: enterosorption, chelating, radioprotective, hyposensitizing, hypocholesterolemic, normalizing gastrointestinal motility and microflora of the gastrointestinal tract [40]. Taking into account the technological features of rice production, the indirectly listed types of action can also be attributed to brown rice that has not been freed from the bran casing.

4.5. Features of the use of rice in diabetes mellitus (DM)

In light of recent nutritional data, in diabetes mellitus, it is recommended to preferentially use foods with a low glycemic index (GI) in the diet and reduce the glycemic index of the diet by enriching the diet with nutrients that reduce postprandial glycemia [11, 58]. For the GI of different rice varieties, the reports are conflicting, most types and varieties of rice are classified as foods with low or moderate GI values, but this depends on the cooking time of the rice, the degree of dextrinization and the type of rice [73].

According to current official guidelines, it is not even the GI of carbohydrates (source or type) that matters more, but the total amount in food or snacks. [eleven]. Therefore, despite the fact that the use of low GI diets can reduce postprandial hyperglycemia, there is still no sufficient reason to recommend low GI diets for diabetic patients [11].

At the same time, the most important principle of therapeutic nutrition for patients with diabetes, from the standpoint of modern dietetics, is the exclusion from the diet of foods and dishes rich in

easily digestible carbohydrates: sugar, honey, jam, chocolate, cakes, cookies, marmalade, as well as semolina and rice groats. These products are used only for the relief of sudden hypoglycemia, as well as in the treatment of ketoacidosis [11, 66].

Attitudes towards white rice in diabetes differ significantly in academic and traditional dietetics (see below).

While there are many studies that have examined the link between high carbohydrate intake and the risk of chronic diseases such as obesity, diabetes mellitus and cardiovascular disease, comparatively few have investigated the role of a particular grain product, rice, especially in Western populations. In Asian populations, where rice is the staple food, some authors have associated higher consumption of white rice with an increased risk of diabetes and metabolic syndrome [73].

As evidence, the results of experimental studies are cited, among other things. According to Y. Jang et al. [71], isocaloric replacement within 16 weeks of refined rice with a product consisting of 66.6% whole grains, 22.2% - legumes, 5.6% - from seeds and 5.6% - from vegetables, was accompanied by a decrease in the content of glucose, insulin, malondialdehyde and homocysteine in the blood of male patients with coronary heart disease, against the background of a decrease in the concentration of 8-epi prostaglandin F (2 α) in the urine by an average of 28%. In addition, in patients who consumed a complex product based on whole grains, an increase in the lipid-corrected level of α -carotene, retinol, tocopherols, and lycopene in the blood was noted by 11–40% [71].

It clarifies that the grain portion of the diet consisted of 22.2% brown rice, 11.1% glutinous brown rice, 22.2% barley, 22.2% black beans, 5.6% sesame seeds, 11.1% coix grains (bead ordinary, or Job's tears - Coix lachrymal). In the diet (220 kcal) of the first group of animals, boiled refined rice weighing 150 g provided 46.6 g of carbohydrates, 3.8 g of protein, 0.73 g of fat, 0.15 g of fiber, 0.42 mg of vitamin E, 0.05 mg vitamin B₁, 0.02 mg vitamin B₂, 0.5 mg niacin, 0.09 mg vitamin B₆, 4.62 g of folate, 0.63 g of saturated fatty acids, 0.84 g of monounsaturated fatty acids, and 0.90 g of polyunsaturated fatty acids.

The diet of the second group of animals, consisting of only 70 g of whole grains and legume powder, provided 35.6 g of carbohydrates, 9.2 g of protein, 5.0 g of fat, 4.2 g of fiber, 28.4 equivalents of retinol vitamin A, 41.0 g carotene, 0.62 mg vitamin E, 0.2 mg vitamin B₁, 0.1 mg vitamin B₂, 2.0 mg niacin, 0.6 mg vitamin B₆, 7.1 g of folate, 0.76 g of saturated fatty acids, 1.27 g of monounsaturated fatty acids, and 2.39 g of polyunsaturated fatty acids [71].

Prospective cohort studies in the United States also associate regular consumption of white rice with an increased risk of developing type 2 diabetes, while consumption of brown rice is, in contrast, associated with a lower risk. These studies, however, were of an overview nature, therefore, they did not allow establishing a reliable "causal relationship", and their results should be refined on the basis of targeted studies [73].

In general, in the so-called "Western" dietetics, meals and side dishes of cereals in the diet of type 2 diabetes patients have very limited use. This is primarily due to the high content of carbohydrates as the main factor determining the postprandial glycemic response [65, 67]. Cereals from rice and, in general, from cereals and other cereals, are high-carbohydrate foods with starch content from 55.4% in buckwheat [12, 16, 23, 57] to 78% in brown rice [23] up to 78% in brown rice [23], as well as sugars - from 1.3% in brown rice to 2.3% in corn [23]. The total carbohydrate content varies from 71.5% in buckwheat groats without heat treatment to 80% in long-grain rice [72].

Also, restrictions on the use of cereals for diabetes are associated with the need to limit the caloric content of the diet and ensure a decrease in body weight in this contingent of patients through the use of products with a lower energy value (mainly vegetables rich in water and dietary fiber) than cereals [65, 66]. In diabetes in obese patients, the principles of diabetes management are the same as those for obesity [67].

Thus, in modern clinical practice, rice (along with wheat and semolina) is one of the products with limited use in diabetes, which is not entirely consistent with the experience of traditional medical systems [23].

Rice for diabetes in traditional medical practice. Causes of the onset and development of diabetes, as well as methodological approaches to the use of cereals for different types of diabetes mellitus from the standpoint of traditional medical systems (Ayurveda, traditional Chinese and Tibetan medicine) was analyzed by us earlier [22, 23, 66].

In BMT in the treatment of diabetes, cereals of sowing rice and glutinous rice are used (section 4.4), since they are, respectively, neutral and warm [3, 22, 23].

In Ayurveda for diabetes, the use of Navann (young grains) is not allowed, while the use of whole grains from the previous harvest is encouraged, especially barley (Java), wheat (Godhuma), flax seed (Kodrava - Paspalum scrobiculatum) and others. With regard to rice, there is no ban on consumption with diabetes, however, the constitutional characteristics of the patient and the causes of diabetes are decisive in the use of rice cereal in the diet for diabetes [5, 23].

In general, it is recommended to take into account the individual ability of each of the cereals to influence different doshas in the body (Tables 12, 13), and the question of the advisability of using cereals in the diet for diabetes should also be decided taking into account the constitutional characteristics and causes of diabetes. Table 12 and 13 show data on the compatibility of grain products and some products from them in accordance with the main constitutional types in Ayurveda (according to [28, 29]). Such recommendations are general in nature and require individualization, taking into account the strength of digestion, the season, the degree of prevalence of the dominant dosha, the possibility of allergic reactions, the form and stage of diabetes, the current state of the body [23].

Since, according to the classical canons, constitutional problems caused by exacerbation of Vata are considered one of the sources of Madhumeah [22, 23], when choosing diet therapy for the prevention and treatment of diabetes, Ayurvedic doctors are guided, among other things, by the normalization of the corresponding dosha. Cereals and grains are generally good for reducing Vata. You always need to cook them in a sufficiently large amount of water. They are considered harmful in dry form (flaked) or in bread with a lot of yeast. Ideal for reducing Vata wheat, spelled, durum wheat (paste); rice, oats, corn, buckwheat, rye, millet, barley are well suited. Not recommended: brown rice; cereal flakes and muesli are strictly excluded [22, 23, 42].

Most grains work well for Pita's constitution, but grains that have a strong warming effect should be excluded. Wheat, spelled, rice are ideal; oats, corn, millet are well suited; not recommended: rye, barley, brown rice, buckwheat [22, 23, 42].

For the Kapha constitution, varieties of cereals are suitable that dissolve mucus, warm and have a diuretic effect, but always monitor the amount eaten. Buckwheat, barley, corn, millet, rye are well suited. Not recommended for diabetes: rice, oats; strictly excluded: wheat, spelled, brown rice [22, 23, 42].

CONCLUSIONS

1. An information-analytical study of traditional and modern scientifically grounded approaches to the medical and food use of rice has been carried out sowing and cereals from it.
2. It has been shown that sowing rice is traditionally a valuable food product in Russia, and its therapeutic and prophylactic use has a modern scientific rationale and a specific list of indications for medical use in both academic and traditional medical practice.
3. Revealed differences in the chemical composition and biological value of brown rice grain, parboiled rice and rice groats that have undergone grinding (white rice), which today is the main product of grain processing entering the domestic trade network.
4. It has been shown that, despite the negative attitude of academic dietetics to the use of rice cereal (white rice) for diabetes, in traditional medical systems this type of rice is widely used in the prevention and treatment of diabetes, taking into account the constitutional type of the patient, the type of diabetes and the nature of the processing of rice grains.

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