Wheat: Opportunities and Potential Risks of Use in Diabetes Mellitus

from the perspective of traditional medicine and modern dietetics

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SUMMARY

In connection with the need to increase the bioavailability of the blueberry polyphenolic complex in the development of specialized food products for patients with type 2 diabetes mellitus, an information-analytical study was carried out to assess the possibility of using wheat for this purpose as one of the sources of vegetable protein. This study was based on the high protein content of wheat, which is required to create a nutritional matrix, and the experience of traditional medical systems in the world on the use of this plant for the prevention and treatment of diabetes mellitus.

Due to the impossibility of including whole grain wheat in the composition of specialized food products and on the basis of an informational study on the potential allergic risks of this type of grain, we concluded that it is inexpedient to use wheat as a vegetable source of protein to create a food matrix enriched with polyphenols in the development of specialized food products for patients with type 2 diabetes.

Key words: wheat, vegetable proteins, diabetes mellitus, food matrix, blueberries, specialized foods, traditional medicine.

RESUME

Our study is devoted to the evaluation of the possibility of using wheat as a source of vegetable protein in the development of specialized foods for patients with type 2 diabetes to improve the bioavailability of the polyphenol complex of blueberries. This study was required due to the high content of wheat protein for the food matrix, and the experience of traditional medical systems in using this plant for diabetes prevention and treatment.

In traditional medicine whole wheat grains are used in the treatment of diabetes, while crushed grains and flour are contraindicated. However, whole wheat should not be included in the composition of specialized foods. In addition, we have revealed high allergological risk of this type of grain. Therefore we do not recommend to use wheat as a vegetable source of protein to create a food matrix enriched with polyphenols.

Keywords: wheat, vegetable protein, diabetes, specialized food products, food matrix, blueberries, traditional medicine.

When developing specialized food products (SPP) for patients with type 2 diabetes mellitus (DM) (grant from the Russian Science Foundation No. 143600041), we faced the problem of choosing cereals for food matrices enriched with blueberry polyphenols in order to create recipes for dry multicomponent mixtures with a modified carbohydrate profile. The problem of using cereals in the development of SPP for patients with type 2 diabetes is due to the modern dietary approach to the formation of the diet of such patients, in particular to limiting the consumption of cereals and cereals in order to reduce the total amount of carbohydrates in the diet and the amount of foods consumed with high and medium glycemic index [10 , 52].

However, we have previously shown the feasibility of an integrative approach to the scientifically substantiated use of cereals in type 2 diabetes due to the presence of traditional experience and modern dietary recommendations for their use for prophylactic and therapeutic purposes in this disease in traditional medical systems of the world [19]. The search for promising plant protein sources (cereals and legumes) for the creation of SPPs used in the diet therapy of type 2 diabetes is due to the need to increase the bioavailability of the polyphenol complex (phytonutrients) with antidiabetic action [47].

An in-depth study of the possibilities and risks of using individual representatives of the Zlakovy family and other cereals with type 2 diabetes, including for the purpose of including them in the SPP, has not been carried out.

The purpose of this informationanalytical research is to study the possibility of using (from the standpoint of traditional medicine and modern dietetics) wheat as a source of vegetable protein to create a food matrix enriched with polyphenols of natural origin

MATERIALS AND METHODS

The objects of the research were bibliographic sources (monographs, scientific periodicals, reference publications, dissertations, dissertation abstracts and textbooks) and thematic Internet resources containing translations of ancient treatises of the main traditional medical systems of the world, as well as regulatory documents and other reliable bibliographic sources: scientific periodicals (PubMed), scientific and official publications and international databases containing information on allergens and side effects of food plants and products based on them.

When assessing allergological risks, we took as a basis information from the electronic database of the official website of the WHO / IUIS Subcommittee on Allergen Nomenclature [53], and also used official materials from EAACI (European Academy of Allergy and Clinical Immunology) [61–63, 67], FDA [59], American Herbal Products Association (AHPA) [54].

The subject of the study was wheat as one of the most widespread grain (cereal) sources of vegetable protein on the planet, with an average glycemic index. The following research methods were used in the work: descriptive quantitative, informational, historical, analytical, evaluative, content analysis, systematization.

RESULTS AND DISCUSSION

1. Justification of the choice of the subject of research

We have previously shown that from the standpoint of an integrative approach to diabetes therapy, cereals and cereals can be promising sources of macro and micronutrients for creating food matrices of dry multicomponent mixtures with a modified carbohydrate profile in the development of SPP for patients with type 2 diabetes. And when choosing specific grain crops (as promising sources of macro and micronutrients) to create food matrices, one should take into account the ratio between the content of various classes of carbohydrates, proteins, vitamins (in particular B1), vital macro and micronutrients, as well as the potential risks of using each from representatives of cereals [19].

Wheat is one of the major crops for global food security (maize, rice and wheat) [43] and the most widespread plant protein source in the world among cereals [29]. According to Osborne's classification, plant storage proteins belong to the classes of prolamins (wheat gliadin, barley hordein, corn zein) and glutelins (rice orysenin, wheat glutenin) [32].

Regardless of the role of reserve proteins in plant physiology or in metabolism, they are, first of all, important for humans because of their contribution to nutritional and energy value, as well as to the functional properties of edible plant materials. Their common property for seeds and tubers is the presence of non-peptide amide bonds. Enzymatic deamidation can increase the solubility of these proteins, as well as improve emulsifying and foaming properties. It is important that reserve proteins of different varieties of the same plant species have different electrophoretic properties, which allows identification and differential diagnosis of varieties [6].

According to the classification [8] (by chemical composition), wheat belongs to the 1st group of cereals with a high starch content, like other cereals (rye, barley, oats).

Botanical characteristics. Wheat (Triticum) is a genus of herbaceous plants of the family. Myatlikovs, a leading grain crop in many countries. Belongs to the Gramineae family, or Poaceae, to which the most basic food plants of mankind belong: soft wheat (Triticum aestivum), sowing rice (Oryza sativa), corn (Zea mays) and many others

grain crops - sources of flour and cereals, fodder plants for domestic animals [28]. Only about 30 wild and cultivated species of this genus are known; of them on the territory of the former USSR - 19 species. Some of them - P. ararat (T.araraticum), P. Urartu (T. urartu), P. boeotic (T. boeoticum), P. Timofeeva (T. timopheevii) are in the Red Book of the USSR [37].

Wheat is unknown in the wild; its origin remains unclear. In Transcaucasia, Afghanistan, Iraq, the greatest diversity of plant species and forms was found, which gives reason to consider these areas as the main area of wheat speciation. Archaeological data show that wheat was grown 5-7 thousand years ago in the countries of Western and Central Asia, in Egypt [16, 28, 37]. According to other sources, the birthplace of many types of wheat (including many varieties of soft and durum wheat) is the Caucasus. In Turkey, Iran, Iraq, Syria, Turkmenistan, it was grown from the 7th to 6th millennium BC, in Western Europe - from the 6th to 2nd millennium BC, in the North Caucasus - from the 1st millennium BC. n. e., on the territory of Belarus and the Baltic states - from the 4-5th century. AD Wheat was introduced to South America in 1528, to the United States in 1602, in Canada it began to be cultivated in 1802,

In world agriculture, naked species are most common: P. soft, or ordinary (T.aestivum, T. vulgare), and P. hard (T. durum). Also in India and Pakistan, P. sphaerococcum is cultivated; in India, Ethiopia and the Russian Federation - spelledemmer, or two-grain (T. disossitis); in Afghanistan,Syria and Armenia - P. dense-headed, or dwarf (T. compactum); in Dagestan, as well as in Armenia,Georgia and Turkey - P. Persian (T.persicum) [37].

The total area of wheat covers all agricultural areas of the world. In the north, the border of its cultivation reaches 66 ° N. (in Sweden), in Russia - experimental crops - up to 76 ° 44 'N. (Murmansk region). In the south, it reaches the southern borders of Australia, South America and Africa. Wheat is predominantly a steppe crop. In Europe, it occupies mainly the steppe and forest-steppe zones, in the North. America - prairies, in South America (Argentina) - pampu, in Australia - steppe and semi-desert areas. Wheat is grown even in the foothill areas at an altitude of up to 4 thousand m [37].

Depending on the spinousness of the spike, its color and pubescence of the spikelet scales, the color of awns and grain, wheat species are subdivided into varieties. Common varieties of soft wheat are erythrospermum, lutescens, milturum, ferrugiveum, albidum, grecum, cesium, barbarossa, erythroleukone, etc. durum wheat - melyanopus, gordeiform, leukurum [37].

In European countries, winter soft wheat is mainly grown, in the northern regions - spring wheat, in the south of the continent - also durum wheat. In Asia, the largest areas are occupied by spring soft wheat, but durum crops are also significant here. In North America, spring (Canada, USA) and winter (USA) soft wheat, as well as durum wheat, are cultivated. In South America (Argentina) and Australia, spring soft wheat prevails, in Africa - spring soft and hard. Sowings of other types of wheat are small [37]. Thus, soft wheat, the most common cultivated plant species, is cultivated on all continents, almost from the Arctic Circle to the southern tip of Africa and South America [16]. On the territory of the former USSR, spring and winter soft wheat is grown. Spring crops are mainly located in areas with a continental climate and low winter temperatures. Winter wheat is cultivated in places with milder winters or with a stable snow cover [16].

Soft wheat - Triticum aestivum L. (T. sativum Lam., T. vulgare Vill.) - an annual plant from 45 cm to 2 m tall, the stems are hollow along the entire length, usually bare. Leaves are linear, flat, 0.3–0.5 cm wide; at the transition from the leaf sheath to the leaf blade, there is a tongue and ears, the latter often with cilia. Inflorescences - ears are two-row, loose, prismatic, less often fusiform or clavate (depending on the variety), up to 12 cm long. Spikelets are sessile, wide side to the spikelet, 3-5-flowered. Spikelet scales with depression at the base and longitudinal rugosity [16]. Fruits are oval or ovoid caryopsis, rounded in cross section, with a pronounced crest, with a longitudinal groove, mealy, semi-vitreous or glassy, white, yellowish or red [16].

Wheat is one of the main food crops in many countries of the world, the most important export item. Its grain is processed into flour, cereals and other products, used for the preparation of animal feed [37]. Moreover, the grown grain is used almost exclusively for flour for bread. In a much smaller amount, it is used for the preparation of cereals, food starch, pasta and confectionery. Grain is necessary in distilling for the manufacture of strong

alcoholic beverages and some types of beer, including the famous English ale [16, 38]. Wheat food products are diverse and have not only nutritional, but also important therapeutic and prophylactic value for humans [16, 38].

Chemical composition. Wheat grain contains carbohydrates: starch (up to65%), fiber (3%) [16], tensile gluten, due to which a good rise of the dough is ensured [21]; proteins (10-15% [16], according to other sources - 13% [21], in some varieties - up to 26% [16]): leucosin, glutenin, gliadin, etc .; free amino acids; fats (up to 2%) [16], according to other sources - 1.5% [21]; vitamins: B1, B2, B6, PP, pantothenic and folic acids, C, provitamin A, E, biotin (vitamin H) [16, 21]; enzymes; minerals: phosphorus, potassium, calcium, magnesium, zinc, iron, cobalt, selenium, etc. [16, 21]. Data on the average chemical composition of wheat in comparison with other cereals (according to [13–15, 46]) are given in table. 1. From the data table. 1 shows that compared to other grains, wheat stands out for its high protein content.

Average chemical composition of semolina as a percentage of absolutely dry matter: starch - 84.2, protein - 12.7, fat - 0.9, fiber - 0.24, ash - 0.54, sugar - 0.96 [25].

Whole wheat flour contains three main parts of the grain: the shell, the aleurone layer, and the germ. Due to this, it is rich in dietary fiber, which is able to remove metabolic products, toxic elements, radionuclides from the body and contribute to the development of a favorable intestinal microflora. It is also rich in vitamins B, E, PP, phosphorus, copper, magnesium, iron, calcium. Wheat contains macro and microelements: potassium, calcium, silicon, magnesium, sodium, sulfur, phosphorus, chlorine, aluminum, boron, vanadium, iron, iodine, cobalt, manganese, copper, molybdenum, nickel, tin, selenium, silver, strontium , titanium, chromium, zinc, zirconium [36].

Wheat, as well as flour and cereals from it, contain 3.4% of essential amino acids (valine520, isoleucine470, leucine860, lysine360, methionine180, threonine390, tryptophan150, phenylalanine500) and 8.4% of nonessential amino acids (alanine460, arginine610, aspartic acid670 glycine470, glutamic acid3350, proline1290, serine600, tyrosine370, cystine230) [36].

The bran contains structural polysaccharides - dietary fiber: fiber, cellulose, hemicellulose, lignin, as well as betaine, fats and protein [34].

Table 1

Average chemical composition of some types of grain (in%) (according to [13–15, 46])

The culture	Water	Squirrels	Carbohydrates			Cell-chat	Fats	Ash	Energy value 100 g (in kJ)
			Total	Mono and disaccharides	Collapse small				
Wheat soft winter	14	11.6	68.7	2.6	53.7	2.4	1.6	1.7	1331
Wheat soft spring	114	12.7	66.6	2.6	52.4	3.4	1.6	1.7	1318
Wheat solid	14	12.5	67.5	2.1	54.9	2,3	1.9	1.8	1339
Barley	14	11.5	65.8	3.6	50.1	4.3	2	2.4	1301
Corn	14	10.3	67.5	2.7	56.9	2.1	4.9	1,2	1406
Rice	14	7.3	63.1	3.1	55.2	9	2	4.6	1213
Buckwheat	14	11.6	59.5	1.5	54.9	10.8	2,3	1.8	1284

2. The use of wheat in diabetes mellitus in traditional medical practice

The main reason for the occurrence of type 2 diabetes and other metabolic diseases, from the standpoint of oriental medicine, is a violation of energy metabolism in the body, due, among other things, to the untimely and unbalanced use of foods of an unsuitable taste (sweet, bitter, sour, salty, spicy), an incorrect balance of energetic "Hot"

“Cold” and “neutral” food products, as well as constitutional and seasonal inadequacy of food and its excessive consumption [16, 19, 31, 44, 50].

Prevention and treatment of diabetes in various traditional medical systems of the world always include diet therapy and provide for a constitutional approach [19].

Traditional Chinese Medicine. From the standpoint of traditional Chinese medicine,The root causes of diabetes can be an excess of “internal heat” and “disturbance of the intrahepatic balance of Yin and Yang,” - syndromes that fully fit into the theory of “dysfunction of the Qi mechanism” [2, 30, 31, 44, 48, 51]. Treatment includes diet therapy (with a predominance of products of "cooling" and harmonizing action), regulation of the immune and endocrine systems; restoration of the functioning of peripheral glands, central nervous system, pituitary gland and hypothalamus; the inclusion of agents that improve enzymatic processes, angioprotectors, choleretic and hepatotropic agents; detoxification procedures and detoxifying herbal ingredients, since under-oxidized fats and nitrogenous substances accumulate in the body of diabetic patients, there are signs of lactic acidosis [19, 31].

One of the rational ways to prevent the development of impaired glucose tolerance in traditional Chinese medicine is the use of energy-intensive "living" foods based on whole grains and cereals, since excessive cravings for sweets indicate a lack of Qi energy in the body and insufficient Spleen function. It is optimal to use cereals and grains of "refreshing", "warm" and "neutral" character [31, 45, 57]. Besides "taste" and "character", according to the theory of traditional Chinese medicine, "entering the channel" is one of the most important properties of the product. This implies that each product acts on certain organs and channels, exerting a selective effect on them. Wheat enters at once into several channels interested in diabetes: Hearts, Spleen (like rice, barley, buckwheat), Kidneys (like buckwheat), exerting a regulatory effect on them [12, 19]. In accordance with the concept of the Five Essential Elements, wheat enhances the primary element Wood, the partner organs of which are the Liver and Gallbladder [39].

From the standpoint of traditional Chinese medicine, wheat (小麦 xiaomai) tastes sweet, the nature of the impact - cooling, refreshing [3]. According to other sources, wheat is sweet and neutral [12], sweet and slightly cold [57], cool, but the properties of coolness are preserved only in grain with an intact shell, and when it is crushed, on the contrary, the property of “heat” appears [3]. Action: balances the mind and the Heart, stops sweating due to asthenia [57], strengthens, nourishes the spirit of the Shen of the Heart, collects (soothes) the devastating sweat generated by emptiness. Refers to products that replenish, nourish Yin. It enters the channel of the Liver, cools, nourishes and soothes it, cools the Heat of the Liver. It is recommended to everyone who has an excited Liver (it is excited in almost all "white" people), as well as to those who have an excess of Heat or Yin Emptiness [3, 4, 12, 19]. Indication [57]: idiopathic sweat, palpitations, night sweats, hysteria (combined with the use of licorice and dates). It is especially useful in spring, but can be consumed all year round (should be limited only in winter) due to its sweet (replenishing) taste and cool (refreshing) properties [9, 19].

Excessive consumption of crushed wheat grain (cereals) and flour products leads to the accumulation of dampness and phlegm in the body [3], which is typical for type 2 diabetes. A contraindication for wheat flour products is SD. At the same time, there are recipes based on whole grains of wheat for "diabetes with thirst and anxiety, with a feeling of tightness and heat in the heart" ("Shi and Xin Jing") - thick porridge "Fan" and liquid porridge "Zhou" [3].

Ayurveda. In Ayurveda, SD has been known since ancient times as Ashrava (Prameha) and / or Madhumeha (madhu - "honey", fur - "urine"). One of the sources of Madhumeh is considered to be constitutional problems caused by the aggravation of Vata (air constitution), which symbolizes wind and dryness, which is characterized by deterioration of the body [5, 19, 26, 40].

Vatadiabetic is divided into 4 types, Kaphadiabetic is divided into 10 types, Pitadiabetic is divided into 6 types. Physical inactivity and indigestion, leading to the accumulation of "specific impurities" that accumulate in the cells of the pancreas and disrupt the production of insulin, are also considered important causes of diabetes mellitus [5, 26, 40]. Excessive consumption of food that is hot (ear), oily (snigdha) and heavy (guru) nature is especially harmful [5, 19].

Treatment should focus not only on maintaining blood glucose levels, but also on rejuvenating the body to avoid further complications. Along with medicine and diet,

providing for the mandatory inclusion of whole grains, the patient is encouraged to lead a healthy, active lifestyle, which contributes to the correct order of brain functioning, as well as rejuvenates the cells and tissues of the body and makes them able to produce insulin again properly [5, 26].

For diabetes in Ayurveda, the use of Navann (young grains) is not allowed, while the use of mature and overwintered grains of wheat (Godhuma), barley (Java), flax seeds (Kodrava Paspalum scrobiculatum) and other whole grains is encouraged [5].

table 2

Grain Compatibility Wheat Grain
with the main constitutional types * in Ayurveda (according to [22, 23])

WATA		PITTA		Kapha	
NO	YES	NO	YES	NO	YES
Couscous			Couscous		Couscous
Spelled			Spelled		Spelled **
	Wheat		Wheat	Wheat	
	Wheat flour durum		Wheat flour durum		Wheat flour durum **
Wheat bran			Wheat bran		Wheat bran

Note:
* The constitutional type is determined by special questionnaires (tests);
* * Allowed to be consumed in moderation.

Table 3

Properties and nature of the influence of grain of some types of wheat and products from it on the doshas

(according to [22])

Product	Taste	Action	Influence on doshas		
			Cotton wool	Pitta	Kapha
Flour pancakes wheat	Sweet	Heavy, oily	↓	↓	↑
Pasta products	Astringent	Heavy, soft	↑	↓	↑
Spelled	Spicy, astringent	Light, dry	↑	↓	↓ (↑)
Wheat	Sweet	Heavy, oily, laxative	↓	↓	↑
Wheat flour durum	Sweet, astringent	Lung	↓	↓	↑

Taking into account the constitutional characteristics and causes of diabetes, when using wheat, like other cereals in the diet, the individual ability of each of them to influence various doshas in the body is taken into account [22, 23, 40]. 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 [19].

According to the classical canons, constitutional problems caused by exacerbation of Vata are considered one of the sources of Madhumeh (DM), therefore, when choosing diet therapy for the prevention and treatment of DM, Ayurvedic doctors are guided, among other things, by the normalization of the corresponding dosha [19, 40]. Wheat grain is ideal for constitutional Vata types (grain should be boiled in large

volume of water) and Pita (in this case, cereals that have a strong warming effect are excluded). At the same time, muesli and flakes are strictly excluded. Wheat is excluded for the Kapha constitution [40] (Table 2).

Table 3 presents information about the properties and effects of wheat on each of the doshas (in accordance with Ayurvedic concepts) according to [22].

Tibetan medicine. According to Tibetan medicine, wheat belongs to the spikecereals that taste sweet after being digested; according to the action on the body - to the means that suppress the passion and the Wind system, as well as generate strength and Mucus [50].

The causes of diabetes, in accordance with the theoretical provisions of Tibetan medicine, can be violations in three regulatory systems: Wind (rlung) - the nervous system, Bile (mkhris) - the digestive system and Mucus (badkan) - the hormonal and lymphatic system, as well as factors of heat and cold, wind and fire, dampness and dryness, unhealthy diet and lifestyle, excessive physical exertion and psycho-emotional overload, trauma and laziness [19, 50].

Most often, the disease occurs in people belonging to the Bile type (overweight, reddish face, irritability, anger), the second most common type of diabetes is the type of Mucus (loose, obese, obese); people with the constitution of the Wind suffer from diabetes much less frequently [50].

In cases where the cause of the disease lies in a disorder of the nervous system (Wind), then (in addition to procedures that increase the level of heat in the body and external methods of exposure), food and medicinal plants are used to restore the balance of the nervous system. If diabetes occurs as a disease of "Cold" (Mucus), then use warming procedures, diet and herbal medicine, which should normalize the weakened "fire" of the stomach and metabolic processes, improve digestion, remove excess mucus, lymph, fluid and fat from the body, increase energy and warmth of life. In cases where diabetes occurs as a disease "Heat" (Bile), a set of food products and the whole range of measures are aimed at normalizing the constitution of Bile, correcting the functioning of the Liver, Gallbladder, Spleen, Pancreas, to cleanse the Blood and Liver and reduce the internal "heat" [50]. In all cases, diet therapy includes properly prepared meals based on cereal crops [19, 41, 50], and each cereal culture has its own character and thermal characteristics [41].

The properties of wheat grain, like other grains and legumes, can change over time and depending on heat treatment [41]. All freshly harvested raw grains (new harvest) are "heavy", and ripe, dry and old grains are "light". Cooked and roasted grains become "lighter", digested and absorbed better, so before cooking porridge, it is useful to fry almost any cereal a little [41, 50]. 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 [50].

Wheat in Tibetan medicine is a cold, heavy, nutritious product [41, 50], heals disorders of the Wind (Vata) and Bile (Pitta) systems [50]. Strengthens the body [49]. Useful for people of Wind, Bile and mixed type BileWind, harmful for Mucus. It is used for diabetes with Wind and Bile [41]. Semolina and other wheat cereals are cooling products [19, 41, 50]. Especially undesirable for Mucus is considered semolina porridge with milk with sugar, which is very useful for the Wind [41, 50].

Application in domestic traditional and folk medicine. In folk medicine, a decoctionwheat bread crumb was used for diarrhea and gastrointestinal bleeding. The bread crumb, soaked in hot milk, was applied to the abscesses to ripen. Wheat flour cakes with honey (1: 1) are effective for post-injection abscesses [16]. In case of female and male infertility, it was considered useful to take fresh juice from grains of wheat of lactic maturity (0.5 cups 2-3 times a day 20 minutes before meals for 1 month) [42]. A decoction of grains was used as a fortifying drink, a decoction of bran with honey - for inflammation of the upper respiratory tract and severe cough [21].

Sprouted grain is used for a large number of diseases, the treatment of which requires strengthening the body's own defenses. It is believed that the consumption of sprouts, as well as decoctions from stems and roots of wheat, plays a significant role in the prevention of the development of malignant neoplasms. Sprouted grain is used in a diet for cancer, pulmonary tuberculosis, bronchitis, pneumonia, stomach and duodenal ulcers, metabolic disorders

a tendency to stone formation, eczema (neurodermatitis) and other diseases [16, 42]. Official medicine treats such treatment with caution [16].

In traditional medicine, a decoction of grains is known as a fortifying (restoring strength after illness) and enveloping agent. Sprouted grain (usually washed and soaked grain sprouts up to 1 mm per day) is an even better known bio and immunostimulant, a source of B vitamins [16]. A decoction of bran with the addition of honey reduces the intensity of the inflammatory process in diseases of the respiratory system, softens the cough. Outwardly, bran poultices are made to soften rough skin and calluses [16].

Application in modern dietetics. Semolina is considered a good children's dietaryfood [21]. The dietary properties not only in baby food, but also in the composition of sparing diets for malnutrition and gastrointestinal diseases are based on its high calorie content and almost complete absence of fiber [16, 21, 42]. They are also due to the almost complete spectrum of free amino acids, including essential ones. Oven-dried white bread rusks are included in the diet of patients with gastric ulcer and duodenal ulcer [17].

Wheat bran is rich in B vitamins, minerals (especially potassium), fiber, therefore they are widely used in diets for constipation, obesity, hypertension, atherosclerosis, cholelithiasis. The use of bran in diabetes mellitus is justified by their property to somewhat lower blood glucose levels [16].

The starch obtained from caryopses is used not only as a food product, but also in medicine as an enveloping agent, in powders and ointments, aqueous solutions - in the form of enemas, and in surgical practice - for the formation of fixed dressings from starch bandages [16, 21] ...

Modern experimental studies have confirmed the antitumor effect of hemicellulose B from soft wheat grains: it has a carcinostatic effect against some types of cancer [16]. The drug "Avemar" was proposed from wheat germ, inhibiting the formation of metastases, the effectiveness of which was confirmed experimentally and even by clinical trials [16]. Presumably, the antimetastatic activity of the drug may be associated with its antiproliferative, apoptosis-enhancing and antioxidant effect. In the experiment, he increased the effectiveness of standard treatment methods, had an immunostimulating effect, while reducing the risk of side effects [16].

The detoxifying effect of wheat bran is due to the presence of structural polysaccharides - dietary fiber: fiber, cellulose, hemicellulose, lignin, as well as betaine, fats and protein [34]. Bran also has the following types of action: hepatoprotective, choleretic, desmutagenic (enterosorption), radioprotective, hyposensitizing, hypocholesterolemic, normalizing the motility of the gastrointestinal tract and microflora of the gastrointestinal tract [34]. For them, participation in the regulation of phase I metabolism and chelation has been described [34].

Thus, in domestic traditional and folk medicine, as well as in modern nutritional practice, there is no experience of using wheat in the diet of patients with diabetes or as an antidiabetic product. In the eastern traditional medical systems, wheat is not only a necessary component of the diet of a healthy and sick person, but also has therapeutic and prophylactic properties, including in metabolic diseases, in particular for most constitutional types with diabetes [3, 11, 12, 19, 24 , 41, 45, 50].

3. Allergic and other risks of using wheat with diabetes mellitus

The widespread introduction of specialized hypoallergenic food products into human nutrition requires the development of an integrated approach to assessing their potential allergenicity, which will minimize the risk of allergic reactions in healthy and sick people who consume these food products [33].

Physician allergists, clinical immunologists, endocrinologists and other specialists should be well informed themselves and are obliged to inform patients about possible side effects and hypersensitivity reactions when using medicinal and food plants [55], however, thematic scientific publications devoted to allergic and other risks of including wheat in specialized food products for patients with type 2 diabetes mellitus, we have not found in the available literature.

Table 4

Allergic components of common wheat (Triticum aestivum), according to [53]

Name	Biochemical name
Tri a 14	Nonspecific lipid transfer protein 1
Tri a 18	Agglutinin isolectin 1
Tri a 19	Omega5 gliadin
Tri a 20	Gamma gliadin
Tri a 25	Thioredoxin
Tri a 26	High molecular weight glutenin
Tri a 36	Low molecular weight glutenin GluB323
Tri a 37	Alpha purothionin
Tri a 41	Mitochondrial ubiquitin ligase activator of NFKB 1
Tri a 42	Hypothetical protein from cDNA
Tri a 43	Hypothetical protein from cDNA
Tri a 44	Endosperm transfer cell specific PR60 precursor
Tri a 45	Elongation factor 1 (EIF1)

Informing doctors and patients about the risk of developing allergic reactions and / or intolerance is an extremely important aspect of preventing the emergence of critical situations for both patients and those who consider themselves healthy people [17, 62, 63]. It is especially important to assess the potential food allergy risks in children.

Early studies did not pay due attention to the possible allergenicity of cereal proteins [33]. However, in recent years, more and more studies are devoted to assessing the allergic risks of proteins in cereals and, above all, wheat. To date, for common wheat, or common wheat (Triticum aestivum), a total of 13 allergic components have been described that belong to different protein families [53] (Table 4).

One allergic component, Tri tu 14, was isolated from durum wheat (Triticum turgidum ssp durum), antibodies to which were detected in most of the examined individuals with baker's asthma or food allergy to wheat [53].

When allergic to wheat, various allergic or immune reactions are possible: anaphylaxis or abdominal colic, skin rash, bronchial asthma and rhinitis (often after contact with raw flour - the so-called baker's asthma) [27]. However, most patients with baker's asthma do not have food allergies to wheat and wheat products. This is explained by different pathways of sensitization (inhalation or oral) and sources of allergens (raw flour or food from it), although wheat allergens such as an alphaamylase inhibitor or LTP are involved in the development of both types of allergy (and in some cases, celiac disease) [56 , 64, 65].

The allergenicity of wheat proteins can be reduced by proteolysis in combination with the destruction of the polysaccharide matrix of the endosperm by cellulose [66]. There are data in the literature on a decrease in the allergenic properties of many food proteins during intense heat and cooking [33, 58]. In the manufacture of wheat-based food products (baked goods, pasta, breakfast cereals, wheat-based baby food, etc.), as a result of heat treatment, the binding capacity of the main soluble wheat proteins is significantly reduced. The digestion process contributes to the further inactivation of already thermostable allergens [27].

Wheat allergy is usually difficult to diagnose, especially in children. This is partly due to the fact that a positive response to wheat flour extract does not always correlate with clinical symptoms [64]. In addition, when performing skin tests or determining sIgE for wheat in patients with grass allergies, these tests are usually positive due to cross-reactivity of the allergens. An incorrect assessment of the diagnostic results entails a recommendation to exclude wheat products from the diet

[27].

According to D.Sh. Macharadze, an acute IgE-dependent reaction to wheat, mediated by its various proteins, is more often observed in young children suffering from atopic dermatitis. In schoolchildren and adults, sensitization to wheat flour does not depend on inhalation of wheat pollen. It is possible that the intake of cereal products promotes the development of tolerance mechanisms (similar to oral immunotherapy) [27].

To date, one of the major components of wheat allergens in both children and adults has been identified - sIgE to omega5gliadin (Tri a l9), which is associated with the risk of developing an IgE-mediated reaction, as well as anaphylaxis to wheat (which is induced by exercise), especially common among adolescents [60, 65]. In accordance with the views of Japanese researchers, the level of IgE to omega-5gliadin should be used as a marker when deciding whether to conduct a food challenge test in patients [60].

Thus, depending on the route of exposure to the allergen, 4 types of IgE-mediated food allergy to wheat are distinguished [27]:

1) classic food allergy, accompanied by involvement of the skin, digestive organs, or respiratory tract [27, 35];

2) exercise-induced anaphylaxis;

3) professional bronchial asthma (baker's asthma) and rhinitis;

4) contact urticaria [64]. So, hydrolyzed wheat protein can cause IgE mediated hypersensitivity not only after ingestion, but also upon contact with the skin [65] (in Japan, several cases of such reactions have been described to soap containing hydrolyzed wheat protein) [27].

Risk analysis of cross-allergic reactions. The National Guidelines forallergology and immunology, cross-allergic reactions have been described for almost all types of grain crops [1].

A high risk of developing cross-allergic reactions exists for all species of plants of the Cereal family, for example, for planting oats, in the case of sensitization to other cereals (rice, wheat, rye, corn, etc.) or grass pollen, corn silk, as well as to Plants of the Cruciferous (Cabbage) and Liliaceae families. Patients with gluten intolerance may develop negative reactions, for example, when taking pharmaceutical drugs or eating oat-based foods [7].

Wheat proteins are characterized by high homology with proteins of other grains. However, the fact that the majority of patients with wheat allergy can consume other grains (eg, corn, rice) indicates the presence of components that do not cross-react with wheat allergens [27].

Wheat cross-reacts to grass pollen, leading to overdiagnosis of wheat pollen allergy. Misdiagnosis often leads to unsuccessful specific immunotherapy. In this case, molecular component allergy diagnostics helps to clarify the clinical situation [27].

4. Evaluation of the feasibility of using wheat as a basis for a food matrix enriched with polyphenols in the development of specialized food products antidiabetic action

Since the diet of patients with diabetes mellitus must contain a sufficient amount of water and fat-soluble vitamins [10], wheat could be considered as their available domestic source. Vitamin B1 (thiamine), which is actively involved in carbohydrate metabolism and the synthesis of the neurotransmitter acetylcholine, is of particular importance in the diet of diabetic patients. The greatest amount of thiamine is found in yeast, wholemeal bread, bran and grains of cereals and other cereal crops [16, 20]. However, with an increase in the quota of carbohydrates in the diet, the need for thiamine also increases [10]. Consequently, when choosing promising grain crops as sources of biologically active substances for creating food matrices, one should take into account the ratio between the content of carbohydrates and vitamin B1. Optimal, apparently, there will be crops with a minimum amount of starch and sugars in the grain with a maximum content of proteins and vitamins, in particular B1 [19]. With diabetes, it is necessary that a sufficient amount of macro and microelements, among which zinc, copper and manganese are important, must be supplied with food, since they indirectly lower blood sugar [18, 19].

On the one hand, the chemical composition of wheat grain (section 1) and the positive experience of its

The use of diabetes in various traditional medical systems of the world (Section 2) allows us to consider this type of cereal as a promising vegetable source of protein for creating food matrices enriched with antidiabetic plant polyphenols. On the other hand, the positive experience of traditional medicine concerns only whole wheat grains, while crushed grain and flour (and only in this form can cereals be added to food matrices) in a number of cases are contraindicated in patients with diabetes. High allergic risks and the inability to use it for celiac disease also speak not in favor of choosing wheat grain (section 3).

Thus, due to the impossibility of including whole grains in specialized food products and on the basis of an informational study of the potential allergic risks of wheat, we concluded that it is inexpedient to use this type of grain as a vegetable source of protein to create a food matrix enriched with polyphenols in the development of specialized food products for patients with type 2 diabetes.

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CONCLUSIONS

1. An information-analytical study was carried out to assess the feasibility the use of wheat (from the standpoint of modern dietetics of medicine and traditional experience) as a promising source of protein for the development of specialized food products for patients with type 2 diabetes mellitus.

2. Revealed data confirming the traditional use of whole grain wheat in traditional Chinese medicine, Ayurveda and Tibetan medicine for diabetes mellitus in some constitutional types of patients, as well as contraindications for the use of cereals from crushed wheat grain and wheat flour for this purpose.

3. High allergic and other risks of using wheat have been identified, including for the development of specialized food products.

4. Due to the impossibility of including in the composition of specialized food products of whole grain and on the basis of an informational study of the potential allergic risks of wheat, it was concluded that it is inexpedient to use this type of grain as a vegetable source of protein to create a food matrix enriched with polyphenols in the development of specialized food products for patients with type 2 diabetes mellitus.

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