Prospects of using natural non-conventional raw materials and secondary raw materials in the production of bread of specific purpose

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Abstract. One of the most important directions in solving the problem of ensuring the food security of the population and improving the environmental situation in the country is the rational use of its own raw materials, including secondary ones, that is, waste from various sectors of the food industry. Their use in the composition of model composite mixtures will significantly expand the range of targeted bakery products, in this case, intended for the prevention and treatment of diseases of the musculoskeletal system. The purpose of the study is the selection and study of the chemical composition and biotechnological potential of raw materials for the production of bakery products for medical and preventive purposes. The objects of the study were germinated wheat grain, sesame seeds and grape pomace. The authors consider it possible to use bioactivated wheat grain and secondary raw materials in the production of this type of product, which will enrich it with the missing essential nutrients, reduce the cost, and also significantly improve the ecological situation of the environment.

1 Introduction

In solving the problem of ensuring the food security of the population and improving the environmental situation in the country, research on the rational use of its own raw materials, including secondary ones, that is, plant waste from various sectors of the food industry, is becoming increasingly important. The problem of utilization of this raw material, which has a relatively high biotechnological potential as a source of proteins, dietary fiber, minerals, vitamins and other essential nutrients, is especially acute for regions with a hot climate. This raw material, as a perishable product, significantly worsens the ecological situation in the region and requires immediate technologically justified and cost-effective processing. In this aspect, very promising are studies on the use of this raw material, positioned as additives - fortifiers, in the production of the most popular socially significant food products, which are bread and bakery products. The creation of model mixtures from various raw materials will significantly expand the range of these products for their intended use, namely, to increase the segment of products for medical and preventive and dietary purposes, to make them more accessible, especially for socially vulnerable segments of the population through the use of cheap secondary raw materials.

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At the actual stage of development of health care in the Republic of Uzbekistan, special attention is paid to the prevention of diseases, as well as the rehabilitation of patients. At the same time, it is important not only to improve the system of medical care for the population, but also the quality of nutrition, since the state of human health directly depends on this. It has been proven that nutrition underlies or is essential in the occurrence, development and course of almost 80.0% of all known pathological conditions that develop because of certain nutritional imbalances, as well as a lack of essential nutrients [1].

Breach of rational nutrition are caused both by the crisis in the production of food raw materials and products, and by a sharp decline in the purchasing power of most of the population of our country. It has been proven, in particular, that an increase in the number of diseases associated with overweight and obesity, atherosclerosis, osteoporosis, hypertension, metabolic disorders, and immunodeficiency states. Osteoporosis ranks fourth among non-communicable diseases after cardiovascular diseases, oncological diseases and diabetes mellitus.

Osteoporosis (OP) is etiopathogenetically related to nutrition and belongs to the so-called alimentary-dependent diseases, called the "silent epidemic of the 21st century". OP is recognized by the World Health Organization (WHO) as one of the most common forms of chronic non-communicable diseases, and its consequences (low-energy fractures, the development of pain, deformities, disability, etc.) are characterized by a high level of comorbidity, mortality and disability, which determines the medical and social and economic relevance of studying this problem [2-4].

The insidiousness of this pathology lies in the fact that many patients learn about it only after the fracture has already occurred, while its constant and stable growth is observed. Thus, according to the WHO, about 35.0% of injured women and 20.0% of men have fractures associated with OP. This problem affects about 75 million citizens of Europe, the USA and Japan. Mortality associated with osteoporotic fractures in developed European countries exceeds cancer. The number of osteoporotic fractures of the femoral neck is expected to increase from 500 thousand to 1 million cases annually. Approximately 10.0% of women over 60 years of age and almost 70.0% of women aged 90 years and above are subject to OP [5, 6].

In this regard, the search for new methods for the prevention and treatment of osteoporosis is of great importance. In these terms, the most promising direction is the enrichment of socially significant products of everyday consumption with the necessary physiologically significant nutrients using nonconventional natural raw materials and herbal supplements [7]. Among these products, bread and bakery products are the most accessible and in demand among all segments of the population, including those with a low social level [8, 9]. Therefore, it is the research on the development of new types of functional bakery products for targeted purposes, in this case for preventive nutrition in OP, which is very relevant [10, 11].

2 Materials and methods

The purpose of research is the selection and study of the chemical composition and biotechnological potential of raw materials for the production of bakery products for medical and preventive purposes.

The task of research was to determine the feasibility of using natural additives - fortifiers in the technology of preparing whole-grain bread varieties for special purposes by studying their chemical composition and modeling composite mixtures.

Objects of study: germinated grain of wheat (Tríticum), sesame seeds (Sesamum indicum L., S. orientale L.), husks of grape (Vítis).

The quality of raw materials and their chemical composition were evaluated on the basis of a priori analysis of specialized literature. The chemical composition of the objects of study was determined according to modern generally accepted methods of physicochemical analysis.

The experimental part of the work was carried out in the laboratories of the Department of Food Technology of the Bukhara Engineering-Technological Institute. The reliability of the obtained data is also confirmed by repeated experiments.

3 Discussion

It is known that the diet for osteoporosis is one of the important components of treatment. In combination with gymnastics and balanced motor activity, it can work wonders. In this regard, the purpose of our research is to study the data on proper nutrition in osteoporosis in addition to the main treatment.

Currently, a number of micronutrients and vitamins have been identified that are involved in the exchange of human bone tissue (Figure 1) [12].

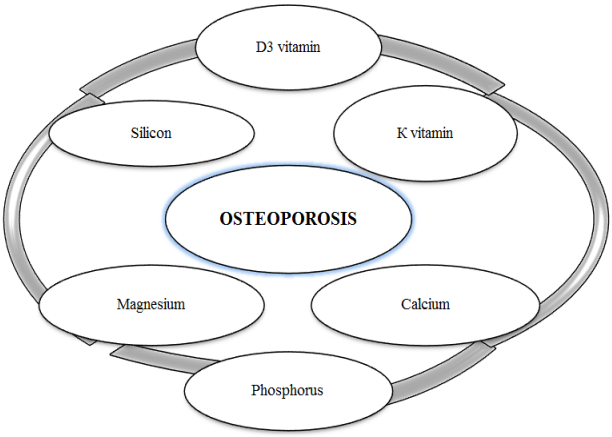

Fig. 1. Micronutrients and vitamins for the prevention and treatment of osteoporosis.

Calcium is necessary for the formation of the human skeleton, the normalization of carbohydrate and water metabolism, blood clotting, regulation of muscle contraction, and the production of certain hormones. Under the influence of strong medications, as well as due to aging, calcium is gradually washed out of the body. This becomes a decisive factor in the development of osteoporosis. It has been established that a deep calcium deficiency contributes to the formation of glucose tolerance, hyperparathyroidism and hypertension within 2–3 weeks. All these effects of calcium and cause extraordinary research interest: in this nutrient.

Phosphorus contributes to the growth of bone tissue and maintaining its integrity, is necessary for the functioning of muscle tissue (skeletal muscle and heart muscle) and activation of the absorption of calcium ions in the intestine.

In addition, the state of phosphorus-calcium metabolism is also important because the maintenance of bone structure is, although the main, but by no means the only physiological role of calcium. The fact is that among the 23,500 proteins of the human proteome, the functions of 2145 proteins (9.0%) depend to some extent on calcium levels. The extra-osseous physiological effects of hypocalcemia on the human body are due to disturbances in the activity of these proteins, which are necessary for the formation of the connective tissue structure, the regulation of inflammation processes, the synthesis of neurotransmitters, the

transmission of signals through nerve endings, the processing of carbohydrates and lipids, blood homeostasis, and the maintenance of blood pressure.

The best vitamins for osteoporosis include magnesium. This nutrient is necessary for the normal functioning of the muscular, cardiovascular, and central and peripheral nervous systems. If we talk about osteoporosis, then the participation of magnesium in protein synthesis, which is necessary for the appearance of new cells in the body, including bone cells, comes to the fore. It directly affects the strength of teeth, hair and nails, therefore it is also often included in complexes with vitamin D3. In chronic magnesium deficiency, the most important aspect of bone mineral metabolism, the Mg:Ca ratio, is disrupted. With a decrease in the Mg:Ca ratio, metabolic processes in the bone are slowed down, toxic metals (primarily cadmium and lead) are deposited faster, the function of the joint gradually worsens, the range of motion decreases, and deformation of the joints and spine occurs. Epidemiological studies of the incidence of osteoporosis in different countries have shown that the higher the Mg:Ca ratio in the diet, the lower the incidence of osteoporosis.

Silicon is one of the mandatory (essential) trace elements that take part in the structure of individual organs and the regulation of vital body functions. Few clinical studies have demonstrated a positive effect of silicon supplements on bone mass and markers of bone metabolism. Attention is drawn to the appearance of combined compounds containing orthosilicic acid, which has maximum bioavailability. However, the potential biological role of silicon and its participation in osteogenesis are not fully understood. The growing attention of the medical community to this important nutrient will increase understanding of its role and place in bone health.

D vitamin is critically important in osteoporosis, as its effect on the body is associated with a complex of immunomodulatory, neuroprotective, antitumor properties, maintaining a balance between adipose and muscle tissues, maintaining genome stability, epigenetic inheritance, and energy metabolism of all cell types. The importance of this vitamin for bone integrity is undeniable. The D vitamin receptor, like the estrogen receptor, is a transcription factor that, in particular, regulates the expression of proteins involved in calcium and phosphorus homeostasis. At the same time, studies conducted over the past decade have shown that K vitamin is also needed to maintain bone structure.

K vitamin is an important mediator in the absorption of both calcium and D vitamin. It is for this reason that it is so important to get them in combination in order to maximize the effect of taking them. In addition to the formation of the basic substance of bone tissue, K vitamin is involved in the regulation of the osteoclast population, supporting their programmed death, and thereby preventing excessive bone resorption [10].

In addition to the described minerals and vitamins for women after 45-50 years, it is recommended to use foods with so-called estrogenic activity (phytoestrogens) in the diet, for example, soy, beans, apricots, and various cereals. It has been established that estrogen deficiency leads to an acceleration of bone metabolism processes with a shift in equilibrium towards bone resorption [13].

The use of sprouted grain in the production of bread is a promising direction. Sprouting promotes the transition of hard-to-digest substances into an easily accessible form, the amount of vitamins and minerals increases, a number of authors [11-14]. In this regard, sprouted grain is a valuable component for the enrichment of bread and bakery products [15, 16].

Therefore, Naumenko et al. [17] developed a bread recipe with the addition of 20.0–30.0% of the sprouted and crushed mixture of durum wheat grains. It has been established that the use of this raw material as an enriching additive allows adjusting the consistency of the dough and avoid the additional introduction of dry wheat gluten or other improvers during the dough preparation process. The use of a sprouted crushed mixture of wheat grains of soft varieties reduces the consumer advantages of finished products (decrease in specific volume,

the presence of a sticky crumb, undeveloped porosity), so it is necessary to correct the traditional recipe and technology.

Authors [14, 15] have developed technologies and recipes of bakery products for gerodietary nutrition based on the use of flaxseed flour and pumpkin seed flour. The optimal dosage of 10.0% flaxseed flour was determined instead of the same value of the prescription amount of varietal wheat flour. The recommended dosage of a mixture of flour from pumpkin seeds and crushed wheat grits is 5.0 and 5.0%, respectively.

Sesame seeds are widely used in the production of bread and breadsticks, buns and bagels, cookies and crackers, pies and waffles. Especially popular is the use of sesame seeds on the surface of such products - to enrich the taste and increase the perceived value and benefits of products [17].

Analysis of the content of physiologically active components of flax seeds allows us confidently considering them an ideal food fortifier. Flax seed proteins are more complete in amino acid composition than wheat and rye flour proteins and can supplement the latter, increasing the value of bakery products. Flaxseed polysaccharides are of practical interest, as they can act as water-retaining agents and binders in the production of bakery products, while providing a protective effect on the digestive system. Flaxseed dietary fibers are of considerable interest, since one of the ways to increase the nutritional value of bakery products is to enrich them with vegetable dietary fibers in the form of bran or in the form of whole-ground flour [18].

A priori analysis of the profiling literature showed that there are enough works on the use of the studied additives in the production of bread and bakery products, but there is practically no information on the use of this raw material in the composition of the composite mixture, which will significantly increase the physiological effect of their combined use in the production of targeted bread.

4 Results

Enrichment of food products with vitamins, minerals, other essential nutrients in order to ensure good nutrition is carried out in accordance with the following basic principles:

- Determining the hygienic safety of new sources of raw materials and finished food products.
- The use of food and flavoring additives in accordance with the existing hygienic requirements imposed by the health authorities.
- Combination of organoleptic indicators of the combined product with people's habits, traditions and national peculiarities in the nutrition of certain population groups.
- Balance of products by main components, storage stability, and availability for the consumer.
- Indication of the direction of the combined product, characterized by a certain nutritional and biological value, the indicators of which are marked on the individual packaging of the product.
- Implementation of purposeful control of quality indicators by state bodies.

In order to determine the functional properties of selected natural additives, positioned as enrichers of the nutritional value of bread and bakery products, the chemical composition was studied and a comparative analysis was made. Data on the chemical composition of the objects of study are given in the Table 1.

Table 1. Chemical composition of the studied oilseed raw materials (averaged data, n=3).

Nutrients	Indicator value					
	Sprouted wheat grain		Sesame seeds		Husks of grape	
	100 g product	100 g dry matter	100 g product	100 g dry matter	100 g product	100 g dry matter
Nutrients, g:						
Water	15.75	-	4.30	-	7.6	-
proteins	12.18	14.46	21.10	22.05	10.45	11.3
carbohydrates	64.15	76.10	18.20	19.00	41.05	44.4
Fat	2.8	3.35	49.00	51.20	11.0	11.9
cellulose	3.02	3.59	5.20	5.45	28.4	30.7
Ash	2.1	2.50	2.20	2.30	1.5	1.7
Minerals, mg:						
Calcium	7.1	8.3	360	376	150	156.7
phosphorus	49.2	58.3	667	697	25.6	26.7
magnesium	12.7	15.1	345	360	96	99.8
silicon	52	61.8	497	519	3.0	4.2
Iron	7.4	8.3	6.4	6.7	170	176.8
Vitamins, mg:						
phyllochinon, K	0.27	0.30	0.30	0.41	48.1	52.2
cholecalcipherol,	0.07	0.08	2.3	2.5	-	-
D_3	0.23	0.27	0.75	0.78	0.09	0.1
thiamine, B_1	0.86	1.02	0.28	0.29	0.04	0.05
riboflavin, B_2	5.9	7.0	4.50	4.70	0.57	0.61
niacin, PP	28.1	33.3	19.17	20.03	0.76	0.83
tocopherol, E						
Energy value, kcal	327.5	-	593.6	-	72.2	
Distinctive minor components	P-active substances: flavonoids, rutin, anthocyanins		Sesamin, sesamoline, sesamol		Resveratol	

For a more objective assessment of the nutritional value of the studied raw materials, the main nutrients were recalculated per 100 g of dry matter. The results of a comparative analysis showed that the largest amount of carbohydrates (76.10 g / 100 g of dry matter) was found in germinated wheat; sesame seeds were characterized by the highest values of protein, fat, minerals and vitamin D3; in husks of grape, the fiber content was found to exceed the similar value in wheat grain and sesame by 8.55 and 5.63 times, respectively.

It should be noted that each of the studied types of raw materials contains unique physiologically significant nutrients, therefore, their use in the form of composite mixtures will significantly fortify their physiological role for the prevention of a whole range of alimentary-dependent diseases.

Flavonoids are involved in many processes occurring in the body - they have an antioxidant effect, reduce blood clotting, reduce capillary fragility and permeability, and improve metabolic processes.

Rutin, which is rich in wheat germ, is effective in combating inflammation and degeneration of cartilage and bone tissue. The ability of rutin to suppress the inflammatory response at the level of chondrocytes is noted, thereby preventing the development of pathologies.

The main task of anthocyanin is to strengthen the walls of blood vessels. Regular intake of anthocyanin improves vision and improves brain performance, prevents the development of stroke [18].

Resveratrol, found in husks of grape, has a wide range of biological properties, including antioxidant, cardioprotective, neuroprotective, anti-inflammatory, anti-cancer, and anti-aging effects. Scientists note that resveratrol activates sirtuins, enzymes that play a role in gene expression, metabolism and aging [19].

Due to the presence of a large amount of calcium, sesame seeds are recommended for osteoporosis. The sesamin contained in sesame causes activation of osteoblast differentiation and is promising as a therapeutic agent in the treatment of osteoporosis

Sesamolin is a natural antioxidant that rejuvenates cells, regulates oxygen metabolism in the body and strengthens the immune system [20].

5 Conclusion

Thereby, it has been established that the relationship between osteoporosis and nutrition is one of the most discussed. Degenerative processes associated with aging, a sedentary lifestyle, irrational and unbalanced nutrition, environmental degradation are becoming an increasing problem not only for individuals, but also for society as a whole. Therefore, it is very important to develop functional products, especially bread and bakery products, for the intended purpose, that is, intended for the prevention of alimentary-dependent diseases.

The use of bioactivated and secondary raw materials (waste) from various branches of the food industry will not only enrich the bread with missing essential nutrients and reduce its cost, but also significantly improve the ecological situation of the environment. It should be noted that the disposal of food production waste is especially relevant for countries with a dry and hot climate, including Uzbekistan, since this raw material quickly begins to deteriorate and thereby pollute the environment. Therefore, as the results of evaluating the effectiveness of enterprises in various industries, including food industry enterprises [21-23], show that the issues of recycling valuable secondary raw materials and research on their integrated use as part of composite mixtures in the production of targeted bread are technologically and economically efficient, have practical and scientific value.

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