

APPLICATION OF PUMPKIN FLOUR IN THE PRODUCTION OF BAKERY PRODUCTS

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Abstract. *The manufacture of new types of food products with increased nutritional value is an important task in the development of the food industry. Because the bread, being the main food product in Uzbekistan, sometimes does not meet the requirements of consumers and has a relatively low nutritional value, the priority areas for the development of the baking industry are to improve its quality and nutritional value. Lately, L.I. Puchkova, R.D. Polandova, V.I. Drobot, T.B. Tsyganova, S.Ya. Koryachkina, I.V. Matveeva, G.G. Dubtsov, L.N. Shatnyuk and many other researchers made significant contribution to the development of research to improve the quality and nutritional value of bread, the development of principles for creating products of a given chemical composition and “healthy nutrition”. Methods of increasing the nutritional value of bread are quite diverse. The most rational way is to introduce into the recipe of bread natural products of plant origin, non-traditional for baking, containing a significant amount of proteins, essential amino acids, vitamins, minerals and dietary fiber that can improve its quality and nutritional value. Among the secondary raw materials of the agro-industrial complex, a significant amount falls on the seeds of gourds, including pumpkins, remaining after obtaining puree, juices, nectars and other products recommended for baby and diet food from the pulp of fruits. At the same time, pumpkin seeds are a valuable and promising source of a whole complex of biologically active substances: vitamins (B₁, B₂, B₆, C, PP), phospholipids, tocopherols, carotenoids, flavonoids, saturated and unsaturated fatty acids, proteins, minerals and other useful substances. However, for various reasons, it is not possible to use them with benefit in full. Modern industry processes pumpkin seeds for pumpkin oil, for which only certain varieties of pumpkin are used, the rest are processed by the canning industry, and valuable pumpkin seeds are usually used as animal feed. In this regard, the development of new technologies for bakery products of increased nutritional value with high consumer properties based on the use of pumpkin seed processing products is relevant, has important scientific and practical significance.*

Keywords: *flour from pumpkin seed, chemical composition, functional properties.*

ПРИМЕНЕНИЕ ТЫКВЕННОЙ МУКИ В ПРОИЗВОДСТВЕ ХЛЕБОБУЛОЧНЫХ ИЗДЕЛИЙ

Аннотация. *Производство новых видов продуктов питания с повышенной пищевой ценностью является важной задачей развития пищевой промышленности. Поскольку хлеб, являясь основным продуктом питания в Узбекистане, иногда не соответствует требованиям потребителей и имеет относительно низкую пищевую ценность, приоритетными направлениями развития хлебопекарной отрасли являются повышение его качества и пищевой ценности. В последнее время Л.И. Пучкова, Р.Д. Поландова, В.И. Дробот, Т.Б. Цыганова, С.Я. Корячкина, И.В. Матвеева, Г.Г. Дубцов, Л.Н. Шатнюк и многие другие исследователи внесли значительный вклад в развитие исследований по повышению качества и пищевой ценности хлеба, разработку принципов*

создания продуктов заданного химического состава и «здорового питания». Способы повышения пищевой ценности хлеба весьма разнообразны. Наиболее рациональным является введение в рецептуру хлеба натуральных продуктов растительного происхождения, нетрадиционных для выпечки, содержащих значительное количество белков, незаменимых аминокислот, витаминов, минеральных веществ и пищевых волокон, что позволяет повысить его качество и пищевую ценность. Среди вторичного сырья агропромышленного комплекса значительное количество приходится на семена бахчевых культур, в том числе тыквы, остающиеся после получения пюре, соков, нектаров и других продуктов, рекомендуемых для детского и диетического питания из мякоти плодов. В то же время семена тыквы являются ценным и перспективным источником целого комплекса биологически активных веществ: витаминов (B1, B2, B6, C, PP), фосфолипидов, токоферолов, каротиноидов, флавоноидов, насыщенных и ненасыщенных жирных кислот, белков, минералы и другие полезные вещества. Однако по разным причинам использовать их с пользой в полном объеме не представляется возможным. Современная промышленность перерабатывает тыквенные семечки на тыквенное масло, для чего используют только отдельные сорта тыквы, остальные перерабатывает консервная промышленность, а ценные тыквенные семечки обычно используют в качестве корма для животных. В связи с этим разработка новых технологий хлебобулочных изделий повышенной пищевой ценности с высокими потребительскими свойствами на основе использования продуктов переработки семян тыквы является актуальной, имеет важное научное и практическое значение.

Ключевые слова: мука из семян тыквы, химический состав, функциональные свойства.

INTRODUCTION.

Flour from pumpkin seeds is produced in two types: from peeled pumpkin seeds and unpeeled seeds (with peel). Flour from peeled seeds has a more delicate structure and a pleasant taste. Before grinding, the seeds are carefully freed from the peel, which undoubtedly affects the taste

In composition, pumpkin seed flour is a protein-vitamin-mineral complex that successfully combines amino acids, vitamins (mainly vitamin C and B vitamins), macro- and microelements (over 50 - iron, potassium, calcium, manganese, phosphorus and zinc) and valuable dietary fibers in its natural form, it is highly digestible.

Proteins contained in pumpkin flour (about 10%) help strengthen immunity, amino acids, i.e. isoleucine, methionine regulate blood sugar levels, which is important for patients with diabetes. is a source of high-grade, well-digestible protein, the content of which in a dry product is at least 10%.

Flour from pumpkin seeds contains nonessential and irreplaceable amino acids, in the absence of which in the nutrition, many vital processes in the body are disturbed and its resistance to diseases (immunity) is reduced. Pumpkin seed flour normalizes metabolism, improves the functioning of major systems and organs, primarily cardiovascular, hematopoietic organs, liver and kidneys, increases mental and physical performance.

Pumpkin flour is compatible with all foods and medicines; moreover, it relieves the toxic load on the liver, while healing it. This functional food product is effective in the fight against

the so-called “diseases of civilization”, i.e. diabetes, atherosclerosis, obesity, liver and prostate diseases.

The role of zinc, one of the sources of which is the above product, in the life of the body is simply invaluable. With a deficiency of these mineral, new cells, including immune ones, are simply not formed in the body, and damaged ones are not restored. With a lack of zinc, adults age faster, and children and adolescents develop worse. Men need it 6-8 times more than women do.

There is almost as much zinc in pumpkin flour as in expensive oysters. Pumpkin flour is a valuable dietary food product.

In the last 25-30 years, extrusion technologies have found wide application in the processing of vegetable raw materials. This method of influencing plant raw materials is due not only to the active development of extrusion technologies and technical means for their implementation, but also to the social order to expand the range of food products with special properties. At the same time, as experience shows, the introduction of extrusion technologies contributes to the production of a wide range of food products, increasing the competitiveness of industries and increasing their economic well-being. Currently, technologies for finished extruded food products and semi-finished products for use in various food production based on raw materials of plant and animal origin have been developed [1, 2, 4, 10, 11].

The results of research of the effect of extrusion processing on the modification of the ultrastructure and texture of the main biopolymers of plant materials are known, which show significant changes in the process of extrusion of proteins, lipids, starch, and dietary fibers of plant materials [3, 8].

Despite the well-known successes in the use of high-temperature short-term extrusion in food technologies, there are practically no scientific data on the ongoing changes in the chemical composition and functional and technological properties in vegetable raw materials when using the thermal vacuum effect in the extruder working process. In this regard, we consider it an urgent direction to study

the chemical composition and functional and technological properties of pumpkin seeds with a coat processed using an extruder equipped with a vacuum chamber [9].

Pumpkin seeds contain a sufficiently large amount of protein, dietary fiber, minerals, polyunsaturated fatty acids and antioxidants, and therefore they can be positioned as a potential source of food ingredients in the development of technologies for functional bakery and flour confectionery products. At the same time, it has been experimentally proved that rational technological parameters of extrusion processing of vegetable raw materials contribute to an increase in the content of soluble dietary fiber, increasing the digestibility of proteins, improving their functional and technological properties, as well as reducing lipid oxidation and neutralizing anti-nutritional substances [6, 8].

From this standpoint, it is of scientific and practical interest to study the influence of the thermal vacuum effect in the working process of an extruder on the chemical composition and functional and technological properties of extruded hard-barked pumpkin seeds that have not been peeled from the seed coat. The features of the processing of this type of raw material include the following: firstly, the seed coat of hard-skinned varieties of pumpkin is thin, but not hard [5]; secondly, the fiber contained in the coat of pumpkin seeds has been considered in recent years as one of the most important functional food ingredients. It follows that vegetable

raw materials containing fiber are a source of insoluble dietary fiber in the technology of functional products [5, 7]. In addition, the extrusion processing of unpeeled pumpkin seeds is due to the possibility of using all useful ingredients in the production of food products, such as bakery and flour confectionery products, as a source of antioxidants, protein and unsaturated fatty acids. Thirdly, extrusion processing of unpeeled pumpkin seeds contributes to resource saving due to the exclusion of the technological operation of removing the coats [3, 8].

The purpose of the research is to evaluate the effect of thermoplastic extrusion with a thermal vacuum effect on the chemical composition and functional and technological properties of pumpkin seeds extruded together with the coat.

The objectives of the research are to determine the chemical composition of extruded pumpkin seeds as a source of functional food ingredients in the technology of functional food products; evaluate the functional and technological properties - water-binding and fat-binding abilities of flour from extruded pumpkin seeds with a coat, which have a significant impact on the formation of the structure, nutritional value and taste indicators of flour confectionery products.

MATERIALS AND METHODS.

We used extruded pumpkin seeds with a coat obtained on a KMZ-2U single-screw extruder equipped with a vacuum chamber, which determines the implementation of new technological possibilities for extrusion processing of food raw materials [9].

Raw unpeeled pumpkin seeds were treated for 10-15 sec at a temperature of 130-140 °C. At the exit from the die of the matrix, the extrudate was cut by rotating knives into particles 1–2 mm long and entered the vacuum chamber, where it swelled, lost moisture and was cooled for a short time.

Determination of the mass fraction of moisture, fat, crude fiber and ash was carried out according to generally accepted methods. The content of total nitrogen was determined by the Kieldahl method with subsequent conversion to crude protein. The water-binding and fat-binding capacity of coated extruded pumpkin seed flour was studied using conventional techniques. The results are presented as the mean of three replicate measurements.

RESULTS

The results of a comparative analysis of the chemical composition of flour from extruded pumpkin seeds and wheat flour of the highest grade are shown in Table 1.

Table 1.

Chemical composition of flour of extruded pumpkin seeds and the highest-grade wheat flour

Name of indicator	Flour of extruded pumpkin seeds with coat	Wheat flour of the highest grade
Moisture content, %	6.3	14.5
Mass fraction of protein, % DM	30.6	12.3
Mass fraction of fat, % DM	33.5	1.3
Mass fraction of fiber, % CB	18.5	0.2
Mass fraction of ash, % DM	6.0	0.6
Nitrogen-free extractives, % DM	11.4	85.6
Minerals, % DM		
Phosphorus	1.5	0.09

Potassium	1.1	0.12
Magnesium	0.57	0.16
Saturated fatty acids (% of total fatty acids)	14.3	19.5
Monounsaturated fatty acids	21.37	14.3
Polyunsaturated fatty acids	64.3	66.2
ω -3	7.4	3.9
ω -6	56.65	62.0
ω -9	21.04	13.0
ω -6: ω -3	7.7:1	15.9:1

The moisture content of the extruded pumpkin seeds is low and makes 6.3%, which can be beneficial when storing the extruded seeds.

Extruded pumpkin seeds contained a high amount of crude protein (30.6%) compared to the protein content of premium wheat flour (12.3%), which characterizes them as a potential source of food protein fortification. Extrusion processing helps to increase the level of protein assimilation, and, consequently, increase the nutritional value of the proteins of extruded vegetable raw materials. These changes are due, according to researchers, inactivation of trypsin inhibitors in the process of extrusion processing of plant materials [6, 8].

The amount of protein in extruded pumpkin seeds is comparable to the protein content of a legume such as soybeans (34.9%). The protein content in the extrudate of pumpkin seeds is significantly higher than in peas (20.5%), beans (21.0%) and lentils (24.0%).

DISCUSSION

The research results correlate with the data of other researchers obtained during the extrusion treatment of pumpkin seeds without a coat at lower temperatures [7].

The mass fraction of fat in extruded pumpkin seeds is 33.5%, which is significantly higher than the level of the indicated indicator in wheat flour (1.3%).

A high content of crude fiber in extruded pumpkin seeds was found - 18.5%, as well as ash - 6.0%.

It is known that endogenous enzymes of the human intestinal tract do not break down fiber, so the consumption of insoluble dietary fiber can reduce the risk of obesity, type 2 diabetes and cardiovascular disease. It can be assumed that the use of extruded pumpkin seeds with a coat in the production of bakery and flour confectionery products will allow the development of a technology for functional products.

The positive properties of such products include the low content of nitrogen-free extractive substances in extruded pumpkin seeds in comparison with wheat flour - 11.4 and 85.6%, respectively.

It has been established that extruded pumpkin seeds with a coat are a source of such useful minerals as phosphorus, potassium and magnesium. These macronutrients perform important functions in the human body.

Phosphorus is involved in the catabolism and anabolism of substances in cells, is part of nucleic acids and a number of enzymes. It should be emphasized that phosphorus compounds are found in all cells of the body.

Potassium is involved in maintaining osmotic pressure in cells, tissues and biological fluids, in the transmission of nerve impulses, and in maintaining acid-base balance.

Magnesium is responsible for the activity of key enzymes involved in metabolism: it is involved in maintaining a stable function of the nervous system and heart muscle; has a vasodilating effect; stimulates bile secretion; increases intestinal motility.

The content of saturated fatty acids in the oil of extruded pumpkin seeds with a coat is 1.4 times lower than in wheat flour. It is believed that a high content of saturated fatty acids can be a risk factor for diabetes, obesity, and cardiovascular disease.

The oil of extruded pumpkin seeds contains 85.67% of unsaturated fatty acids; the content of polyunsaturated fatty acids is especially high. The amount of unsaturated fatty acids in wheat flour is lower - 80.5%.

It is known that unsaturated fatty acids, such as linoleic, have a beneficial effect on the human body and the immune system, as well as reduce the risk of diabetes, cardiovascular and oncological diseases.

In accordance with the basics of rational nutrition, the optimal ratio of polyunsaturated fatty acids of groups ω -6 : ω -3 in the daily diet of a healthy person is the ratio (5-10) : 1, and for therapeutic nutrition from 3:1 to 5:1. Therefore, the results obtained (Table 3) indicate the optimal ratio of polyunsaturated fatty acids in the oil of extruded pumpkin seeds in comparison with the ratio of these acids in wheat flour.

The high content of fat, protein, fiber, and minerals characterizes coated pumpkin seed extrudate as a potential source of functional food ingredients.

Replacing part of wheat flour with flour from extruded pumpkin coated seeds in the technology of flour products will allow varying the chemical composition of finished products in a wide range. In addition, by changing the amount of macrocomponents (proteins, fats, dietary fiber) present in extruded pumpkin seeds, it is possible to produce bakery and flour confectionery products with a given nutritional value.

CONCLUSION.

The study of the chemical composition of the extrudate of pumpkin seeds with a coat indicates a high content of protein, dietary fiber, polyunsaturated fatty acids, as well as the presence of a wide range of minerals, which characterizes the resulting product as an effective additive in the development of technologies for bakery and flour confectionery products for functional purposes. High water-binding and fat-binding abilities of the extrudate of pumpkin seeds with the coat will ensure the formation of the desired structure, nutritional value, taste indicators in the production of such products.

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