

Wafers for a Vegetarian Diet: Development of a Recipe with High-Protein Flour from Sunflower Grist "Bioprotein"

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Received: January 13, 2022

Accepted: March 24, 2022

Published: March 26, 2022

Citation: Tkeshelashvili ME, Bobozhonova GA, Ananiev MA. 2022. Wafers for a Vegetarian Diet: Development of a Recipe with High-Protein Flour from Sunflower Grist "Bioprotein". *J Food Chem Nanotechnol* 8(1): 21-25.

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Abstract

Recently, the problem of proper nutrition is relevant. People increasingly began to switch over to a vegetarian lifestyle. A significant issue in nutrition of vegan or strict vegetarians is the amount of protein and especially its biological value. Therefore, this study aims to simulate the composition of a flour confectionery product that meets the requirements of a vegan worldview and, at the same time, has a functional focus. The object of development is wafers with fat filling, enriched with complete protein, with a full replacement of sugar with sweeteners and the addition of dried strawberries powder or cocoa solids, depending on the recipe. Based on the laboratory tests, the composition of the filling was selected, which made it possible to enrich wafer products with protein and reduce calorie content. In addition high-protein flour "Bioprotein" obtained from sunflower grist is used for providing a high protein content in the product and the data on the amino acid composition of high-protein flour from sunflower grist are presented. Maltitol is used as a sugar substitute, and stevioside is used as a sweetener. The nutritional value of the developed wafer products has been calculated; the results obtained confirm the effectiveness of the selected recipe compositions, which are characterized by high protein content. A comparative analysis of the developed samples with the traditional recipe composition, nutritional value and caloric content of wafer products has been carried out. Thus, wafers with fat filling have been developed, which contain only plant raw materials, and are recommended for inclusion in the diet of a person adhering to a vegetarian diet, including vegans, as well as the elderly and people who take care of their health.

Keywords

Nutritional value, Wafer products, Vegetarian diet

Introduction

Nowadays, vegetarian food is becoming more and more popular in many countries of the world, including Russia. The main reasons for this tendency are health problems as well as ethical, environmental and social issues [1].

There are different types of vegetarianism, which are very different from each other. The diet of lacto-vegetarians is based on grains, vegetables, fruits, legumes, seeds, nuts, milk products, and eggs. Lacto-vegetarians do not eat eggs. The diet of vegans, or strict vegetarians, excludes the consumption of meat, poultry, fish, seafood, eggs, milk products, cheese and butter as well [1, 2].

Veganism is a worldview that provides for the exclusion of eating all animal food products, as well as the exclusion from everyday life of things made from animals, cosmetic, hygiene and even medicines that are tested on animals, the

exclusion from leisure the visit of entertainment events related to exploitation of animals (zoos, circuses, dolphinariums) [3].

A comparative analysis of actual nutrition was carried out and differences in the consumption of products and nutrients by persons with various types of nutrition were revealed [1, 2]. Insufficient caloric content, reduced consumption of proteins, fats, carbohydrates, vitamin B₁₂ in the diet of vegans have been established [1].

Vegans, like no other, are faced with a protein deficiency. Protein sources are mainly vegetables, cereals and baked goods in groups of people with a strict vegetarian diet [1]. Plant-based products are not as high in protein as meat, fish, or milk products, so vegans should be careful about their diet. The protein intake of vegans reaches 40.9 g, this amount of protein is considered insufficient, does not meet the recommended physiological norms. The physiological requirement for protein for the adult population is 12-14% of the daily energy requirement: from 75 to 114 g/day for men and from 60 to 90 g/day for women [4].

Thus, the amount of protein and especially its biological value is a significant problem in vegan diet.

Most vegetarians are sweet tooth. The main reason is that it needs to take care of the amount of macronutrients from food with a plant-based diet, since there are easy to miss. It is not enough just to refuse of animal products, it is necessary to carefully select and plan the diet in order to avoid a serious deficiency of essential nutrients [1, 2]. The organism tries to replenish the lack of energy with carbohydrates, primarily fast ones. Therefore, almost all vegetarians like confectionery products.

Vegetarian confectionery shops open not only in Russia, but also in Europe, the USA and even in Asia. Foreign analysts believe that the pace of sales of vegetarian desserts will increase every year. Experts consider that confectioners who will soon introduce vegetarian desserts into their assortment will occupy a leading position in sales in the industry.

However, as the offer expands, so does consumer expectations. Thus, the success of modern vegetarian products depends on whether they can satisfy the consumer with a familiar flavor and texture.

The aim of this study is to simulate the composition of a flour confectionery product that meets the requirements of a vegan worldview and, at the same time, has a functional focus.

The following tasks were solved to achieve target goal:

- Selection and justification of raw materials that provide the required properties of goods;
- Development of recipe composition for wafers with increased biological value using plant materials;
- Determination of indicators of nutritional value and quality indicators of the developed goods.

The nutritional composition of most confectioneries produced according to classic recipes is characterized by a high content of simple carbohydrates, fats and does not contain a sufficient amount of protein, vitamins, macro- and microele-

ments. Therefore, the main task in the development of this group of products is to increase the nutritional and biological value using the raw materials available for production.

High-protein flour "Bioprotein", obtained from sunflower grist with a protein content of 45-48%, can be a promising source of protein substances, is recommended for use in the meat, bakery, confectionery and feed industry [5].

The protein in flour from sunflower grist is rich in amino acids that are deficient for humans (arginine, methionine, cysteine, tryptophane); moreover, unlike wheat, it does not contain gluten and is hypoallergenic. Minerals - potassium, calcium, magnesium, sulfur, phosphorus are in an organic bio-available form and are highly utilization.

Vegans often balk animal products and it does not stop there. Many vegans avoid the consumption of white sugar, a traditional ingredient including in the formula of confectionery.

The modification of the carbohydrate profile of the developed confectionery products provided for the exclusion of sucrose from their composition and the use of maltitol as a sweetener and stevioside as a sweetener in this study. There is an increased risk of caries among vegetarians [6]. Maltitol does not cause caries and has minor limitations for diabetic patients [7].

Materials and Methods

Materials

High-protein flour from sunflower grist («OZRKD Biotech-pro» LLC), a functional food product of deep biotechnological processing of sunflower grist has flavor and aroma, neutral color made in accordance with TC 10.41.42-001-10152018-2019 "High-protein flour from sunflower grist "Bioprotein ". Technical conditions.

Natural sugar substitute maltitol (SHANDONG LUJIAN BIOLOGICAL TECHNOLOGY CO., LTD, China). Sweet flavor, about 80% of the sweetness of sucrose. The caloric content of maltitol is 238 kcal.

Stevioside "GL Stevia" ST80 (Xinghua GL Stevia Co., Ltd, China) is an extract from stevia leaves, a sweetener of natural plant-based origin.

Vegetable oil: refined bleached deodorized coconut (CAR-GILL PALM PRODUCTS SDN.BHD., Malaysia).

Inuline from chicory (Cosucra Groupe Warcoing S.A., Belgium), soluble dietary fiber obtained by natural extraction from chicory roots, an easily dispersible fine-grained white powder that gives a special flavor to the product. As a member of the fructan group, inuline is a non-digestible oligosaccharide built from fructose residues.

Almond kernel paste ("Production company" August Topfer ", LTD, Russia), is a soft small-kernel viscous-flowing mixture of roasted almond kernel, developed based on TC 9761-002-80518490-15.

Dried strawberries, powder (TD "Mazurin", LTD, Russia) is produced from 100% ripe, freshly frozen, fragrant strawber-

ries by freeze drying, which allows to completely preserve all typical qualities for strawberries (aroma, flavor and color).

Alkalized cocoa solids with reduced fat content ("Barry Callebaut NL Russia" LTD, Russia).

Determination of the qualitative and amino acid composition of high-protein flour from sunflower grist

The content of crude protein in high-protein flour from sunflower grist was determined by the Kjeldahl method, crude ash - by mineralization at 500-525 °C, carbohydrates - by the phenol-sulfur method, the concentration of reducing substances and polysaccharides - by the Bertrand-Schoorl method, and dry substances - by the thermogravimetry method, crude fat - by extraction with hexane. The concentration of protein substances in solutions was determined by the Kjeldahl method. Determination of the content of minerals - by the ICP-AES method. The amino acid composition of high-protein flour from sunflower grist was determined by capillary electrophoresis on a "Capel 103R" analyzer.

Sensory evaluation

Organoleptic quality indicators were determined in accordance with the requirements of the normative technical documentation for this type of product by controlling the product sample. The tasting was attended by 5 specialists with experience in the industry from 10 to 15 years. The assessment was carried out on a 10-point scale according to the following criteria: appearance, aroma, flavor and aftertaste.

Indicators of nutritional value and caloric content

The indicators of the nutritional value of products were determined by calculation. The nutritional value of the product is given per 100 grams of product. The amount of proteins, fats, carbohydrates in the product is indicated in grams.

The conversion coefficients of the main nutrients of food products into the caloric content (energy content) of food products was used when determining the energy value (caloric content) of products. The caloric content (energy content) of the products are indicated in joules and calories.

Results and Discussion

The ingredients traditionally used in formulas for wafers with fat filling: sugar, butter, egg powder, milk powder, prevent their wide consumption by different categories of people, including vegans. However, wafers are an important and favorite component of the diet of all age groups of the population.

Options for optimizing the wafer formula are proposed. In the study [8], the choice of fructose as a sugar substitute for making wafers with a low glycemic index was founded. In the study [9], sugar in the wafer formula was partially replaced with powder from girasol tubers. Moreover, due to the use of defatted sunflower lecithin, the amount of egg yolk is reduced by 40%.

The use of a high content of instant skimmed milk powder, flower pollen and walnut oil made it possible to reduce the amount of confectionery fat and powdered sugar in the

formula composition of the fatty filling and increase the nutritional and biological value of wafers [10]. The assortment of wafers for preventive purposes was expanded by replacing part of the confectionery fat in the filling with wheat germ oil enriched with antioxidant - vitamin E and polyunsaturated fatty acids [11].

A wafer product for preventive purposes has been developed, the fat filling of which contains a mixture of citrose, dried goat milk and dry extract of licorice root, a mixture of powder from apricot and pomegranate seeds and rice starch [12].

However, the problem of optimizing the formula using only vegetable raw materials has not been solved and is relevant and promising. Therefore, we have studied the possibility of using non-traditional raw materials of natural origin in the composition of wafer fat fillings.

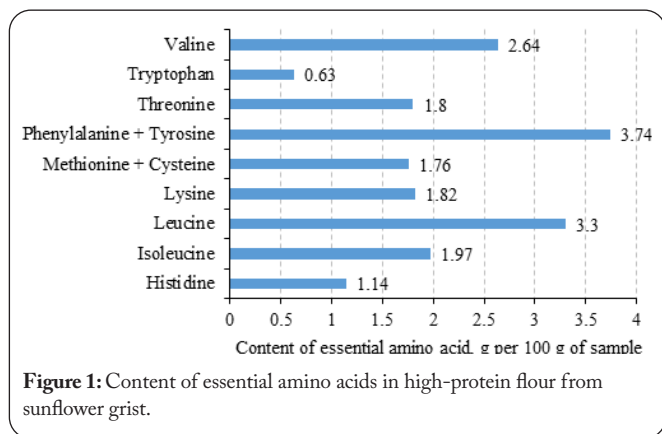
At the first stage, researches were carried out to establish the nutritional and biological value of high-protein flour from sunflower grist (Table 1). Table 1 shows the analysis data of a sample of a product containing 45.0% crude protein. The actual protein content of high-protein flour from sunflower grist will depend on the specific batch of raw materials used.

The results obtained indicate that the amino acid composition of high-protein flour from sunflower grist is distinguished by the presence of all essential amino acids, a high content of glutamic and asparaginic acids, arginine, as well as glycine, alanine, proline, serine and tyrosine. (Figure 1).

At the second stage of this study proposes the use of this high-protein flour from sunflower grist in the recipe compo-

Table 1: The qualitative composition of high-protein flour from sunflower grist according to the product sample.

Parameter		%DM
Total	Moisture %	9.90
	Dry Matter %	90.10
Minerals Ash including		10.48
	Calcium	0.54
	Phosphorus	1.48
	Magnesium	0.86
	Potassium	2.14
	Sulfur	0.69
Proteins	Crude Protein	45.00
	Adjusted Protein	45.00
Crude Fat		1.46
Carbohydrates		33.16
including		
Non Fiber Carbohydrates including		25.20
	Non Structural Carbo- hydrates	11.10
	Sugar	11.00
	Starch	0.10
Structural Carbohydrates		7.96



sition of wafers with fat filling in order to increase the protein content in them.

Another feature of the developed formula was the exclusion of sugar and the introduction of an ingredient that does not cause a hyperglycemic effect - the polyhydric alcohol maltitol (E965). Maltitol is produced by the hydrogenation of maltose, which is made from starch. The sweetness coefficient of maltitol relative to sucrose is 0.8. On technological properties it is close to sucrose [7]. Developed products with maltitol are characterized by reduced calorie content. Compared to sucrose and other polyols, it has a very low hygroscopicity, which makes it easier to create conditions for long-term storage [13].

The recipes include a natural sweetener to obtain a balanced taste - stevia extract (stevioside). The sweet taste of stevia is due to the substances of the glycosidic form (200-300 times sweeter than sugar). Stevia contains 11-15% protein, vitamins, minerals. It has no calories and does not affect blood glucose levels. Stevia is recommended for the prevention of carbohydrate metabolism disorders, obesity, atherosclerosis, pancreatitis and diabetes [13].

Inulin was added to enrich the product with dietary fiber. Inulin, obtained from chicory, promotes the excretion of cholesterol, radionuclides, heavy metals, has a hypoglycemic, choleric, anti-inflammatory, sedative, immunostimulating effect. Inulin belongs to the class of dietary fiber, which has a so-called prebiotic effect. Inulin is not absorbed by the body, and at the same time it is useful for normal digestion, as it stimulates the growth of the activity of beneficial bacteria in the human intestine [14].

Depending on the recipe dried strawberry powder or co-

coa solids was used to obtain wafer products of high gustatory quality.

Based on the conducted laboratory tests, the composition of the filling was selected, which made it possible to enrich wafer products with protein and reduce calorie content. The formula composition of wafer products is shown in table 2.

The nutritional value of wafer products was calculated, the results obtained confirmed the effectiveness of the selected composition of raw materials: an increase in the protein content in the finished product by 14.0-19.5% (Table 3). A comparative analysis of the nutritional value of traditional and testing samples of wafer products showed that the developed products exceed the traditional sample in terms of protein content by 2.8-3.9 times, while reducing carbohydrates by 1.6 times and caloric content by 1.1 times (Table 3).

The manufacturing process of the developed wafers with fat filling does not differ from that used in the production of most wafers with filling and provides for the following operations: preparation of raw materials for production, preparation of wafer sheets and filling, formation of a wafer layer, cooling and cutting of layers, wrapping and packaging.

The high content of proteins in the filling causes increase in its fluidity and disrupts the process of spreading the filling on a wafer sheet, also does not allow to provide the required ratio of the filling to the sheet during the preparation of the layer, complicates the procedure for cutting the layer. The fat content in the filling was increased to 37-38% to ensure the manufacturability of the process and to minimize the return-

Table 3: Essential nutrient content of wafers.

Indicator	Traditional wafers with fat filling	Enriched wafers	
		Testing sample №1	Testing sample №2
Content, g per 100 g - protein	5.0	14.0	19.5
- fats	28.0	32.0	33.0
- carbohydrates	63.0	40.0	38.0
Caloric content 100 g, kcal/kJ	530/2210	470/1950	5 0 0 /2090

Table 2: The formula of wafer goods.

Goods	Composition
Wafers without filling	drinking water, wheat flour of general purpose, edible salt, refined deodorized sunflower oil, emulsifier - soy lecithin, baking powder - sodium acid carbonate
Testing sample №1	plant fat, maltitol, wafers sheet, high-protein flour from sunflower grist, almond kernel paste, freeze-dried strawberry powder, inuline, E322 emulsifier, stevioside sweetener
Testing sample №2	plant fat, maltitol, wafers sheet, high-protein flour from sunflower grist, almond kernel paste, cocoa solids, inuline, emulsifier E322, stevioside sweetener, crystal vanillin flavor
Traditional wafers with fat filling	drinking water, sugar, premium wheat flour, confectionery fat, cocoa solids, dried whole milk, sunflower oil, dry egg melange, soy lecithin emulsifier, salt, baking powder - sodium acid carbonate, vanilla flavor, acidity regulator - lemon acid

able waste in the preparation of wafers. The fat was used for special purposes with a low content of trans-isomer, not more than 1%.

The fat used to prepare the filling was preliminarily melted to a temperature of 35–38 °C. The filling was prepared in a ball mill in a batch process. The weighed raw materials according to the recipe were loaded into a ball mill in the following sequence: plant fat in the amount of 85% of the recipe amount, high-protein flour from sunflower grist and maltitol. The loaded components were mixed, grinding for 2 minutes. Then the rest of the recipe components were loaded: freeze-dried strawberry powder / cocoa solids, soy lecithin, previously diluted with the remaining amount of plant fat, stevioside, inuline, almond kernel paste.

The mixture was mixed until incorporated was obtained, then the ground mass was unloaded from a ball mill into a mix-machine, introducing a flavoring agent.

The wafer layer was formed from the ratio: 20% - wafer sheet, 80% filling.

Technological properties of semi-finished products: wafer sheet and filling, allow the production of this product on existing processing lines without additional fettling and adjustment.

The high organoleptic assessment of the obtained wafer samples was confirmed by the taste panel. In all appearance parameters, the developed wafers meet the requirements of GOST for this category of confectionery products. All wafer sheets are evenly colored, the surface of the wafers with a clear pattern, smooth edges without streaks. The filling practically anywhere protrudes beyond the edges. The wafer sheet is contact with the filling.

A soft and at the same time expressive aroma, in which tones of well-baked wafers sheets and fillings are intertwined. At the break, the aroma is noticeably enhanced and becomes more characteristic of a particular type of wafer. Experts noted the optimal flavor balance, as well as a very successful combination of two textures - a crispy wafers sheet and a soft filling. The wafers are moderately sweet, with an appropriate flavor. The aftertaste is expressive with a predominance of tones of fillings of the corresponding variety. The filling is of a homogenous consistency, without grains and lumps.

Conclusion

The result of the research carried out, the compositions of the filling masses for wafers were modeled that meet the requirements of a vegan worldview and, at the same time, have a functional focus. Wafer products contain raw materials only of plant-based origin, including a non-traditional type of raw material: high-protein flour from sunflower grist. The developed product can be recommended for inclusion in the diet of a person adhering to a vegetarian diet, as well as elderly and people who take care of their health.

Acknowledgements

None.

Conflict of Interest

None.

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