The effectiveness of the use of psyllium in the production of functional products

Olga Krotova[1*], *Valeria* Orobinskaya[2], *Natalia* Vertiy[3], *Elena* Sklyarenko[4], *Oksana* Konieva[5], and *Elnur* Kaitmazov[6]

[1] Don State Technical University, 1, Gagarin Sq., 344003, Rostov-on-Don, Russia
[2] Pyatigorsk Institute (branch) North Caucasus Federal University, 357500, ave. 40 years of October, 56, Pyatigorsk, Russia
[3]Rostov State Medical University of the Ministry of Health of the Russian Federation, 29, Nakhichevansky Lane, Rostov-on-Don, 344022, Russia
[4]Don State Agrarian University, Novocherkassk Engineering and Reclamation Institute named after A.K.Kortunov, Novocherkassk, 111 Pushkinskaya str., 346428, Novocherkassk, Russia
[5]Kalmyk State University named after B.B. Gorodovikov, Pushkin str., 11, 358000, Elista, Republic of Kalmykia
[6]Dagestan State Medical University, 180, Magomed Hajiyev str., 367000, RD, Makhachkala

Abstract. Wheat flour bread plays an important role in the human diet. Currently, great attention is being paid to the creation of functional products with increased biological value and having a preventive or wellness effect. One of the ways to enrich the functional ones is to add various additives. In this paper, the possibility of enriching classic wheat flour bread with psyllium is considered. One of these products is psilium, a powder obtained from the husks of plantain plant seeds. Psyllium is known for its effects on the human body, especially on the gastrointestinal system. The supplement is a natural vegetable fiber, most of which is fiber, which is necessary for humans, it promotes the growth of beneficial intestinal microflora and ensures the normal functioning of the gastrointestinal tract, and subsequently the entire body. The aim of the research was to obtain wheat bread with high nutritional and biological advantages, to give the product preventive and health–improving properties, as well as to add psyllium as an additive. The nutritional and energy value of the developed product has been determined. It was found that the developed bread surpasses the control sample in terms of the composition of food and biologically active substances, since it contains more dietary fiber and is more dietary, taking into account the energy value per 100 grams.

1 Introduction

Bread production is one of the most ancient and important branches of the food industry, as bakery products occupy an important place in the human diet. Wheat flour bread is a source of essential nutrients for the body, such as carbohydrates, proteins, fats, vitamins and minerals. Every year, more and more attention is paid to the creation of products with

* Corresponding author: alb9652@yandex.ru

increased nutritional value that have beneficial properties for human health. One of the promising directions is the use of additives of plant origin, which can improve the quality of bread and make it more useful for consumers [1, 2]. One of these products is psyllium, a natural vegetable fiber, most of which is fiber, which is necessary for a person to grow beneficial intestinal microflora and ensure the normal functioning of the gastrointestinal tract, and subsequently the entire body [3,4].

The purpose of the research is to obtain wheat bread with high nutritional and biological advantages, to give the product preventive and health–improving properties, as well as to add psyllium as an additive [5,6].

The authors have set and completed the following tasks:

- justification of the choice of food product;
- study of the effect of psyllium additive on the organoleptic and physico-chemical parameters of the product;
- investigation of the level of safety and suitability of the product for food consumption.

Due to its unique properties and nutritional value, psyllium is used in baking to increase the viscosity and stability of the dough [7,8,9]. However, it is worth noting that the addition of Psyllium requires a number of additional actions. irstly, before kneading the dough, it is necessary to dissolve the additive sifted through a sieve in water, therefore it is necessary to add psyllium at the "dissolution" stage, along with sugar and salt, it is also worth noting that mixing should be carried out until a homogeneous mass is formed, and after kneading, given that it will take longer to obtain a homogeneous mass masses, compared to the classic recipe[10,11,12].

Psyllium in optimal dosage has a number of positive effects on the human body, and also has special properties that can be used in various fields:

1. Prebiotic effect. Psilium is a source of fiber, which is necessary for the healthy functioning of the gastrointestinal tract, namely, it promotes the growth and nutrition of beneficial bacteria in the intestine. In addition, psyllium passes through the entire intestine without adsorbing and completely disintegrating, which helps to remove fecal matter;
2. Lowering blood sugar levels. With sufficient consumption, the absorption of carbohydrates slows down, which levels out the spikes in glucose in the blood;
3. Weight loss. Due to the peculiarity of psyllium to form a viscous mass, food is not able to digest quickly, which gives the body a gradual feeling of satiety, which ensures control over appetite;
4. Lowering cholesterol. The swelling of plantain seeds in the gastrointestinal tract allows you to feel full for longer, helping to avoid overeating, which reduces triglyceride levels;
5. Lowering blood pressure. Studies conducted on both humans and animals show the same results, regardless of gender, age and lifestyle;

In the production of bakery products. Since psilium lacks digestible carbohydrates, it can be used as an alternative to gluten in baking [13,14].

Thus, the inclusion of psyllium in the production process of wheat bread makes it possible to improve its quality and structure, as well as to ensure the functional properties of the product [15]. The use of psilium is an environmentally friendly and safe way to improve the properties of bread and is a useful food product for consumers [16].

2 Materials and methods

To conduct the research, an analysis and study of normative and scientific literature was carried out. The main document was GOST 58233-2018 "Bread made from wheat flour. Technical conditions", based on which an organoleptic evaluation of the samples was carried out. The physico-chemical analysis was carried out in accordance with GOST 21094-75

(determination of bread moisture), GOST 5669-96 (determination of bread porosity), GOST 5670-96 (determination of acidity by the accelerated method is carried out in accordance). To determine the microbiological safety, a general microbiological analysis was carried out, during which the contents or absence of various microorganisms in the product were determined. Such an analysis includes sample preparation, culture media, identification of organisms using biochemical tests, and counting the volumes of microorganisms. At the end, a final assessment is carried out, which is based on the conformity of products with the safety standards described in GOST.

For the production of a new improved type of bread, a classic recipe was chosen, including: wheat flour of the first grade, water, sugar, salt, sunflower oil and yeast, according to the sourdough method.

Wheat flour. The most important product of grain processing is bakery wheat flour of various grades, which are regulated by GOST 26574-2017. The chemical composition of flour depends entirely on the quality of the grain and the wheat variety. The KBZHU of premium wheat flour is as follows: energy value – 1396/334 kJ/kcal, proteins – 10.3 g, fats – 1.1 g and carbohydrates – 70.6 g.

The quality of flour is determined by the gas-forming ability, the strength of flour, its color, the ability to darken during use and the particle size. In this case, it is necessary to use premium flour that meets the requirements of GOST 26574-2017 "Baking wheat flour. Technical conditions".

Drinking water. Water is also one of the main components of bread, it must first of all be safe in epidemiological and radiation terms, also have favorable organoleptic characteristics and be full-fledged in the composition of macro- and microelements. The main document controlling water quality is the requirements of SanPiN 2.14.1074-01 "Drinking water. Hygienic requirements for the water quality of centralized drinking water supply systems. Quality control". The presence of aquatic organisms is not allowed in drinking water.

Pressed baking yeast. Pressed baking yeast consists of an accumulation of yeast cells from one of the Saccharomyces cerevisiae races. Baking yeast contains on average: 68.0-75.0% water, 13.0-14.0% protein, 1.8% fiber, 0.9-2.0% fat, 1.77-2.5% ash. The composition also includes vitamins D, B1, B2, B6, PP, pantothenic acid, folic acid, biotin and a rich mineral composition. The use of high-quality yeast directly affects the finished product. The control of organoleptic and physico-chemical parameters is carried out in accordance with GOST 54731-2011 "Pressed baking yeast. Technical conditions".

Edible salt. Salt is used of the first or second grade. The quality of salt is controlled by GOST 51574-2018 "Food salt. General technical conditions", it is well soluble in water, must meet the parameters of purity, moisture level.

Refined sunflower oil. The described bread uses vegetable refined deodorized oil, controlled by GOST 1129-2013 "Sunflower oil. Technical conditions", according to which the oil must be transparent, without sediment, odorless, and free of impurities.

Sugar. Granulated sugar conforming to GOST 33222-2015 "White sugar. Technical conditions", i.e. white, homogeneous, sweet–tasting sugar, highly soluble - without sediment.

Wheat bread is one of the key food products widely used in world cooking. Bread increases the satisfaction of the human body's needs for vitamins and minerals, as well as plant fibers and protein, which are also necessary to maintain the health of the body.

The increase in nutritional value can be carried out by regulating the chemical composition by introducing biologically active additives of various kinds. There is also a change in product development technologies – enhanced control of the quantity and quality of the ingredients introduced. A natural prebiotic, psyllium, has been selected as an additive.

Psyllium is a product of plant origin, which is the husk of the seeds of Platango ovato, otherwise known as plantain flea, which grows in India, southern Eurasia, and North Africa. The seeds of this plant contain about 70% soluble plant fibers. Per 100 grams of psyllium

husk there are 2.5 g of protein, 0.5 g of fat, 4 g of carbohydrates, 86 g of dietary fiber, 13.8 g of water, and the calorie content is 162 kcal. Psilium is rich in B vitamins, macro- and microelements such as potassium, calcium, magnesium, phosphorus, iron, manganese, copper, selenium and zinc, and also contains interchangeable and essential amino acids, saturated, monounsaturated and polyunsaturated fatty acids.

Psyllium powder is produced by grinding, which is a universal product, as it can be used as part of dietary supplements, in its pure form, used in the food industry, as well as pharmaceuticals.

The optimal dosage has a number of positive effects on the human body. Psyllium is a source of fiber, which is necessary for the healthy functioning of the gastrointestinal tract, namely, it promotes the growth and nutrition of beneficial bacteria in the intestine. In addition, psyllium passes through the entire intestine, forming mucus with water, not adsorbing and not completely disintegrating, helping to remove feces. With sufficient consumption, the absorption of carbohydrates slows down, which stabilizes glucose spikes in the blood, in addition, forming a viscous mass, food is not able to digest quickly, which gives the body a gradual feeling of satiety and a long feeling of satiety. It is also important that psyllium lacks digestible carbohydrates, so it can be used as an alternative to gluten in baking.

3 Results

To determine the effective dosage of psyllium in the bakery product formulation, an organoleptic analysis of control and experimental samples of bakery products was carried out. As a control formulation, the formulation of a bakery product made of premium wheat flour was used, in which part of the wheat flour was replaced with psyllium in the amount of 0.5%, 1.5%, and 2.5%. The dough for bakery products was prepared using a sponge method (on a conventional sponge), while psyllium was introduced at the dough kneading stage.

The quality of the obtained bakery products with psyllium was assessed by the organoleptic method on a 30-point scale.

Data on the assessment of the quality of the obtained bakery products are presented in Table 1 and the diagram shown in Figure 1.

Table 1. The effect of wheat flour dosages on organoleptic properties bread indicators

The name of the indicator (its significance coefficient)	The value of the indicator for the bread sample, points			
	control	experimental		
		0,5 %	1,5 %	2,5 %
Form (κ = 3,0)	8,0	6,3	7,5	8,0
Surface (κ = 1,5)	4,3	3,8	4,2	4,3
Crumb condition (κ = 2,0)	5,7	5,0	5,5	6,1
Smell (κ = 1,0)	2,9	2,5	2,6	2,7
Taste (κ = 2,5)	7,5	7,3	7,5	7,5
The amount of points	28,4	24,9	27,3	28,6

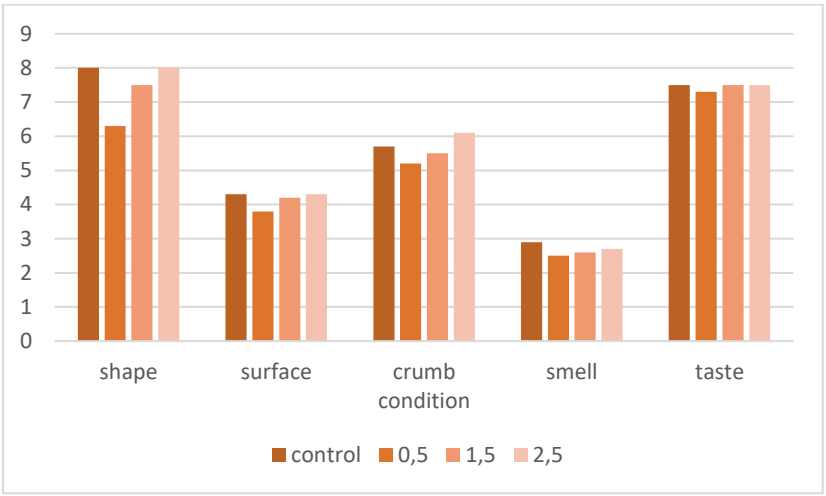

Fig. 1. Diagram "The effect of psyllium dosages on organoleptic parameters"

4 Discussion of the results

From the above data, it can be seen that the control sample and experimental samples of bread with psyllium in the amount of 1.5% and 2.5% instead of wheat flour can be attributed to excellent quality according to organoleptic indicators, and the experimental sample with 0.5% psyllium can be attributed to good quality. The sample scored the most points with a 2.5% contribution.

Based on the conducted research, a new bread recipe has been developed for 500 kg per shift, which is shown in Table 2 and the diagram shown in Figure 2.

Table 2. Recipe of bakery product with psyllium

Name of the raw material	Quantity of raw materials, kg	
	control	developed
Wheat flour baking of the highest grade	468,6	456,9
Psyllium	-	11,7
Pressed baking yeast	4,7	4,7
Sugar	10,3	10,3
Food salt	7	7
Refined deodorized sunflower oil	9,4	9,4
Total	500	500

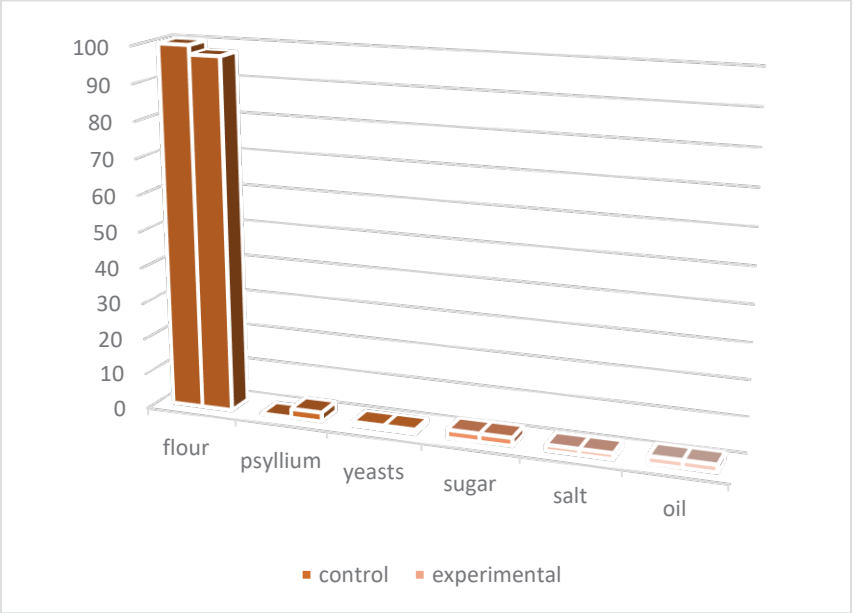

Fig. 2. Diagram "Ratio of ingredients in the recipe of wheat bread"

The technological modes of production of the developed bakery product are presented in Table 3.

Table 3. Technological modes of bread

Technological stage and modes	The value of the technological regime	
	control	developed
1	2	3
Preparation of sourdough: - temperature, 0C - duration of fermentation, minutes	 30 210	 30 210
Dissolution and mixing: - temperature, 0C - duration, minutes	 25 2	 25 10
Preparation of the dough: - temperature, 0C - duration, minutes	 30 70	 30 90
Proofing of workpieces: - temperature, 0C - duration, minutes - relative humidity of the air, %	 36 40 78	 36 40 78
Bakery products: - duration, minutes - temperature, 0C	 25 220	 25 220

Thus, the production modes of bakery products using psyllium have been clarified, providing for the preparation of dough in a sponge method (on a conventional sponge). To prepare the dough, part of the flour is mixed with water and yeast, mixed to a homogeneous liquid consistency (temperature 30 0C) and left to ferment for 210 minutes. The remaining water of 25 °C is mixed with salt, sugar and psyllium – thoroughly mixed, then the dough is kneaded on the finished dough for 25 minutes, introducing the remaining part of the flour into the dough, water with dissolved salt, sugar and psyllium, refined deodorized oil. Knead the dough (temperature 30 0C) and leave to ferment for 90 minutes. At the next stage, the dough is cut into dough pieces by mass and their molding is carried out. The resulting products are soldered in a proofing chamber for 40 minutes at a temperature of 36 0C and a relative humidity of 78%. The bread is baked for 25 minutes at a temperature of 220 ° C.

The bakery product, developed according to the developed formulation and refined technological modes, meets the requirements of GOST 58233-2018 in terms of organoleptic and physico-chemical parameters. The experimental sample had a smooth, crack-free surface, uniform porosity and a light brown color with a grayish tinge characteristic of this type of product. A slight change in the physico-chemical parameters of the experimental sample was noted, compared with the control sample.

The sample met the safety requirements established by TR CU 021/2011 "On food safety", the data on the nutritional and energy value of the control and developed samples of bakery products and the level of satisfaction of the daily need for nutrients during their consumption. In order to determine the compliance of the developed bakery product with the safety requirements established by TR CU 021/2011 "On Food safety", safety indicators were determined. The safety indicators of bread are presented in Table 4.

Table 4. Safety indicators of bakery products with psyllium

The name of the indicator	The value of the indicator	Requirements of TR CU 021/2011, no more
Mass fraction of toxic elements, mg/kg:		
Lead	0,04	0,35
Arsenic	0,03	0,15
Mercury	0,00002	0,015
Cadmium	0,03	0,07
Mass fraction of pesticides, mg/kg:		
DDT	0,005	0,02
HCG	0,009	0,50
Mycotoxins, mg/kg:		
Aflatoxin B1	not detected	0,005
Deoxynivalenol	not detected	0,7

From the data given in Table 4, it can be seen that, in terms of safety indicators, the developed bakery product meets the requirements of TR CU 021/2011 "On food safety". The data on the nutritional and energy value of the control and developed samples of bakery products and the level of satisfaction of the daily nutrient requirement for their consumption are shown in Table 5 and the diagram shown in Figure 3.

Table 5. Nutritional and energy value of control and experimental samples of bakery products

The name of food and biologically active substances	The content of food and biologically active substances in bread				Daily requirement, g (mg)
	the control		experimental		
	content in 100 g	meeting the daily requirement,%	content in 100 g	meeting the daily requirement, %	
Protein, g	6,9	9,6	6,9	9,6	72
Fat, g	1,5	1,8	1,4	1,7	83
Mono and disaccharides, g	44,1	12,1	43,0	11,7	366
Dietary fiber, g	2,2	11,0	4,2	21	20
PUFA, g	0,2	1,2	0,2	1,2	16
Macro- and microelements, mg:					
Potassium	76,1	3,0	77,0	3,1	2500
Calcium	11,2	1,1	11,4	1,14	1000
Magnesium	10,1	2,5	10,1	2,5	400
Phosphorus	53,5	6,7	53,5	6,7	800
Iron	0,75	7,5	0,77	7,7	10
Vitamins, mg:					
B_1	0,10	6,7	0,10	6,7	1,5
B_2	0,11	6,1	0,11	6,1	1,8
B_5	0,20	4,0	0,20	4,0	5
PP	1,9	9,5	1,9	9,5	20
E	0,9	6,0	0,9	6,0	15
Energy value, kcal / kJ	221,9/928,4	9,5	200,9/841,1	8,03	2500/10467

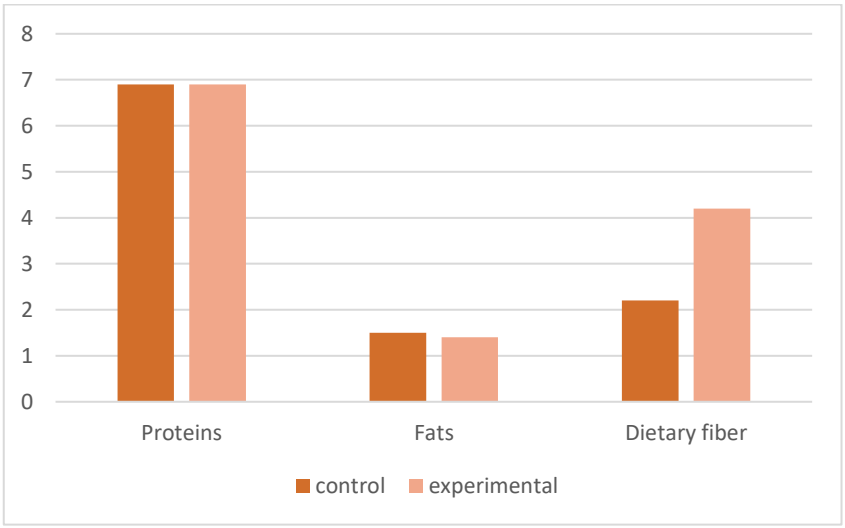

Fig. 3. Diagram "Ratio of the content of the main indicators of nutritional value"

5 Conclusions

Thus, it was found that bread prepared using psyllium is superior in the composition of food and biologically active substances to the control sample, since it contains more dietary fiber. The energy value of the developed bread, compared with the control one, decreases on average by less than 21 kcal per 100 g of the product. It was also found that the developed bread according to organoleptic, physico-chemical and microbiological parameters meet the requirements of GOST 58233-2018 "Wheat flour bread. Technical conditions".

By consuming 100 g of a bakery product enriched with psyllium, the level of satisfaction of the daily need for dietary fiber will be 21% of the recommended one, which allows the product to be classified as a group of functional products. The expected economic effect from the introduction of technological solutions and the sale of 500 kg of the product under study will amount to 6.8 thousand rubles.Thus, the inclusion of psyllium in the production process of wheat bread makes it possible to improve its quality and structure, as well as to ensure the functional properties of the product. The use of psilium is an environmentally friendly and safe way to improve the properties of bread and is a useful food product for consumers.

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