

Development of Wellness Grain Bread

Maryna MARDAR*, Rafaela ZNACHEK

Odessa National Academy of Food Technologies, Department of Marketing, Business and Trade
Kanatna str., 112, Odesa, Ukraine

*Corresponding author: marinamardar2003@gmail.com

Abstract

The goal of the research was to develop new wellness spelt-based grain bread with the inclusion of vegetable additives (powders of milk thistle, ashberry, rosehip and green tea extract). On the basis of marketing research and methodology of deployment of the quality function, the expediency of expanding the range and bringing new bread of improved quality to the market has been justified. The optimal composition of bread was determined by the method of mathematical modeling of the formulation composition and experimental studies. The assessment of quality of the developed products on the basis of the analysis of organoleptic indicators of quality, food and biological value, safety indicators has been carried out. The protein content of the enriched bread is 15.2...16.1 g/100 g of product, a fiber content of 2.5...3.3 g/100 g of product with a corresponding reduction in starch content. The analysis of quality control of new grain bread on biological activity and medical and biological assessment have been investigated and carried out. Herbal supplements have high biological activity. The highest values have rosehip and ashberry powders the activity of which is 2,375 CU, 1,250 CU respectively. The value of the biological activity of spelt is 2.55 times higher than that of ordinary wheat and is 156 CU. The inclusion of enriching additives in the composition of products causes an increase in the biological activity of grain bread. The highest biological activity has bread with the addition of rosehip and ashberry, the activity is 300 CU and 265 CU respectively. According to the results of medical and biological studies, it was found that the products have antioxidant activity and hepatoprotective effect, they can be recommended both in mass and in preventive nutrition of people. The changes in the quality indicators of the developed products during storage and the impact on these changes of different types of packaging were investigated; as a result, the guaranteed shelf life is 6 months.

Key Words: Grain crisp bread, Spelt, Enriching additives, Milk thistle, Ashberry, Rosehip, Green tea extract, Wellness products.

1. Introduction

The health of the population is the highest value, an essential component of the development and socio-economic prosperity of the country. Studies of the nutritionists suggest that in modern society only one traditional diet inevitably results in certain types of food deficiency. The reasons for this are well-known—protein deficiency, lack of vitamins and other macro - and micronutrients, the use of refined foods, the widespread use of various food additives that have no biological value. Nutrition should contribute to the adaptation of the human body to adverse environmental factors. In this regard the functions of nutrition are not only to meet the physiological needs of the body in

nutrients and energy, but also to improve human health, prevent alimentary-dependent diseases (Simakhina G.O., Naumenko N.V., 2016).

The solution of this issue is possible due to the creation of enriched food products based on grain, because for a relatively low cost of raw materials; they are available to the general population, are traditional and are able to compensate for the lack of biologically active substances (BAS) in the diet, increase resistance of the body to adverse environmental factors and, consequently, increase the life expectancy of the population. However, not enough attention is paid to the studies aimed at the formation of consumer properties of grain products, namely, wellness grain bread in order to

better meet the needs of the target category of consumers.

2. Goal and tasks of the study

The goal of the work was to develop new wellness grain bread of the improved quality.

To achieve this goal it is necessary to solve the following tasks:

- on the basis of marketing research to justify the feasibility of developing new grain bread of improved quality;
- to optimize the formulation of new products with specified consumer properties using mathematical modeling;
- to assess the quality of new products and on the basis of biomedical research to show the possibility of their use in the preventive nutrition of the population;
- to investigate changes in consumer properties of grain bread during storage and to establish the possible shelf life.

3. Results of studies

In order to justify the feasibility of developing new products, as well as to identify the main potential buyers, marketing studies of consumer motivations and preferences when choosing grain bread were performed (Mardar M. R., Znachek R. R., Lazutkina A. V., 2013). The study was performed in Odessa and Odessa region. It was attended by 150 people of different occupations, financial and family status, education and gender. On the basis of studies it was found that respondents at purchase of grain bread first of all give preference to such factors as structure/safety of a product, taste and price (Fig. 1). When choosing the type of grain bread, it was found that 30% of respondents prefer wheat bread, 26% – bread based on a mixture of grain crops, 21% – rye. In future the results were taken into account in the development of the formulation of grain bread.

According to the results of marketing research and based on the analysis of references, it was decided to use spelt as the main raw material in the production of bread and introduce enriching additives (milk thistle, rosehip, ashberry and green tea extract). Spelt (*Triticum spelta* L.) is valued for its high content of proteins, lipids, dietary fiber and biologically active substances (BAS) (Hospodarenko G. M., Kostohryz P. V., Liubych V. V. Speltwheat, 2016). The content of carbohydrates in spelt is less than in ordinary wheat. But it should be noted that it contains a

special type of soluble carbohydrates-mucopolysaccharides (mucopolysaccharides), which are able to strengthen the immune system, reduce cholesterol, regulate blood clotting [3, 4]. Spelt contains less reducing sugars and has a low sugar-forming capacity compared to the traditional types of wheat. The protein content reaches 19.5 %; it contains about 20 % of albumin and globulins (Hospodarenko G. M., Kostohryz P. V., Liubych V. V. Speltwheat, 2016; Kohajdová Z., Karovičová J., 2008). Digestibility of spelt proteins – 80.1 %, wheat–78.9 % (Pruska-Kedzior A., Kedzior Z., Klockiewicz-Kaminska E., 2008). A significant advantage of spelt compared with genetically close to it soft wheat is significantly lower content of gluten protein, which causes celiac disease in humans (Bogatytseva T. G., Iunikhina E. V., Stepanova A. V., 2013). Compared to wheat, spelt has vitamins B, E, Niacin and on average 30-60 % higher content of minerals (Fe, Cu, Mg, P, K, Zn, Se) (Trozzi C., Raffaelli F., Vignini A., Nanetti L., Gesuita R., Mazzanti L., 2017).

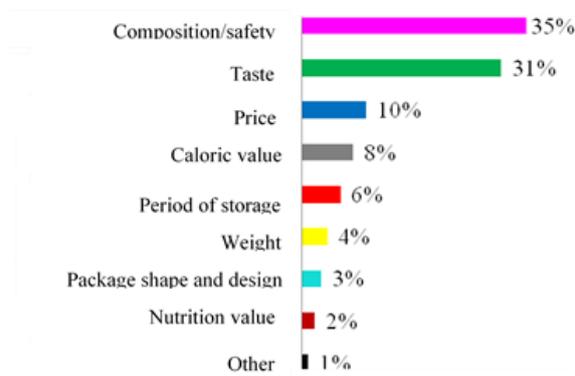


Fig. 1. Factors influencing the choice of respondents when buying grain crispbread, % of respondents

On the basis of mathematical modeling the optimum formulation of new grain bread has been justified (M. Mardar, N. Tkachenko, R. Znachek, C. Leonardi, 2017). For this purpose a volumetric mass (VM, kg/m³), swelling degree (SD, cm³/g) organoleptic evaluation (OE, points) and quality integrated index (QII), which takes into account the cumulative impact of bulk density, sensory evaluation, the swelling degree and the weight coefficients (WC) of the individual indicators were selected as the optimization criteria. Independent factors that varied were mass fraction of table salt (MFTS %) and enriching additives (EA, %). Mass fraction of spelt was determined in such a way that the mixture of all components was 100%. The

response function, which has the form of a polynomial of the second degree, is chosen for modeling. The cumulative effect of the mass fraction of

table salt and additives on the optimization criteria is graphically presented in Fig. 2, 3 (as illustrated by grain bread with milk thistle).

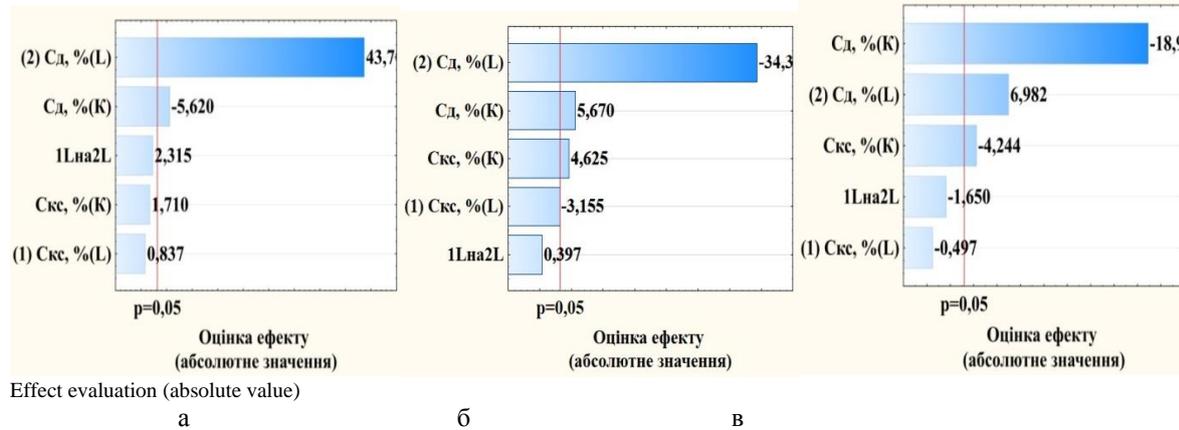


Fig. 2. Pareto Diagram to check the significance of regression coefficients: a – volumetric mass (VM); b – swelling degree (SD); c – organoleptic evaluation (OLE)

According to results it was found that an optimum value of the mass fraction of powder of milk thistle and salt of bread with milk thistle is 5.27 and 0.92%, respectively; the mass fraction of ashberry powder and table salt of the bread with ashberry amounts to 4.34 and 0.92%; mass fraction of rosehip powder and table salt of the bread with rosehip is 4,73 and 1.02%; optimal values of the mass fraction of green tea extract and table salt of the bread with green tea extract is 0.47% and 1.01%, respectively. With this data the maximum value of QII is achieved.

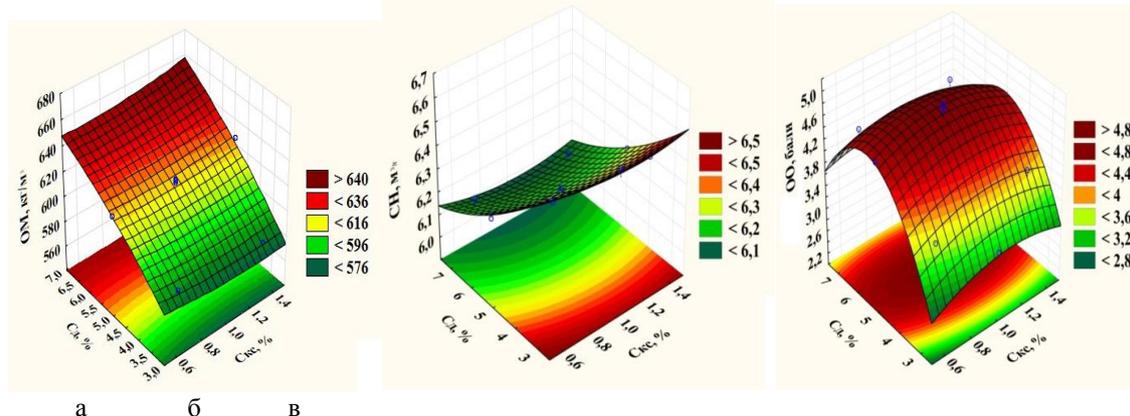


Fig. 3. Dependence of volumetric mass (VM) (a), swelling degree (SD) (b), organoleptic evaluation (OLE) on mass fraction of milk thistle powder (Sd, %) and mass fraction of table salt (Sts, %)

On the basis of the developed formulation the experimental samples were developed in the laboratory and the quality of the enriched grain bread was evaluated according to organoleptic parameters, food and biological value, as well as medical and biological studies were performed.

According to the results of the organoleptic analysis it is established that introduction of vegetable additives into composition of the enrichment of bread results in the improvement of organoleptic indicators of the finished products. The products were distinguished by an attractive appearance, crisp structure, light cream color, pleasant taste and a pronounced smell of additives used. Comparative analysis of the nutritional value of the

prototypes showed that the developed products have increased nutritional value (Table. 1). The protein content of the enriched bread is 15.2...to 16.1 g/100 g of product. Also, the products are characterized by a high content of fiber with a corresponding decrease in the starch content. Developed bread is rich in ash elements. Among minerals there are macro- and microelements. This is also confirmed by the references (Escarnot E., Jacquemin J-M., Agneessens R., 2017), according to which spelt compared to wheat has an average of 30 – 60% higher content of Fe, Cu, Mg, P, K, Zn, Se. The introduction of vegetable additives into the composition of grain bread results in the increase in the content of some vitamins, for

example, the content of ascorbic acid in bread with rosehip is 20.5 mg/100 g due to the introduction of this additive.

The study of the biological activity (BA) of both finished grain bread and the components that make up the products showed that the BA of spelt is 1.98 times higher in relation to wheat of the traditional variety "Kuyalnyk" (M. Mardar, S. Vikul, R. Znachek, T. Bordun, 2018). This is due

to the improved amino acid composition of spelt, which is confirmed by our studies. Regarding enriching additives, the highest BA possess rosehip powders (2375 c.u. and ashberry (1250 c.u.). These additives are characterized by the presence of antioxidant substances, namely flavonoids, anthocyanins, ascorbic acid, tocopherol, which causes a high value of BA.

Table 1. Chemical composition and energy value of new bread

Nutritional substances	Grain bread			
	with rosehip	with ashberry	with milk thistle	with green tea extract
<i>g/100 g of the product</i>				
Proteins	15.31	15.21	16.10	15.46
Fats	1.74	1.75	2.34	1.80
Starch	60.10	59.90	59.50	62.30
Mono - and disaccharides	3.30	3.10	2.46	2.50
Cellulose	2.80	2.60	3.30	2.35
Energy value, kcal	312	316	321	324
<i>mg/100 g of the product</i>				
Thiamine	0.33	0.34	0.33	0.34
Ascorbic acid	20.50	2.60	0.12	0.10
Niacin	6.50	6.48	6.30	6.50
Folic acid, ug	41.6	41.4	41.0	43.1
Potassium	340.0	346.0	344.0	350.0
Calcium	42.2	42.1	103.6	43.0
Magnesium	128.0	128.0	148.0	131.0

On determining the BA of the finished products (Fig. 4) the most important are bread with the addition of rosehip and ashberry, their BA was 300 c. u. and 265 c. u. accordingly, also due to the inclusion of these additives, there is a significant synergistic effect of the interaction of the components of BAS. Thus, the selected BA additives and their introduction into the composition of the bread makes it possible to obtain wellness products, that meets the requirements of the potential consumers.

To confirm the biological effect of new grain bread, medical and biological studies were performed in vivo in order to substantiate the possibility of using bread in preventive nutrition [M. Mardar, S. Vikul, R. Znachek, T. Bordun, 2018]. Medical and biological studies of grain bread on laboratory animals (white rats of Wistar line) confirmed the results of BA and indicate that the developed products have antioxidant activity and hepatoprotective effect. They reduce the level of liver markers almost to normal, which indicates the hepatoprotective effectiveness of bread with

the inclusion of milk thistle. Regarding the effect of additives on the degree of dysbiosis and the content of malondialdehyde it was found that new products have antioxidant properties.

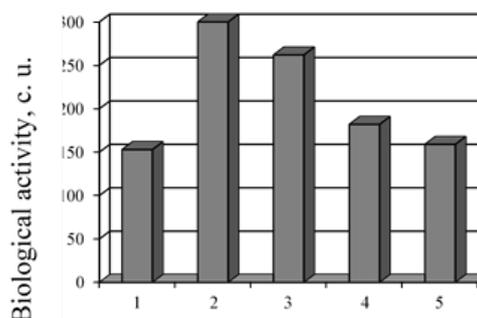


Fig. 4. Biological activity of grain bread: 1 – control; 2 – bread with rosehip; 3 – bread with ashberry; 4 – bread with milk thistle; 5 – bread with green tea extract

In accordance with the tasks the study of changes in consumer properties (organoleptic, physical and chemical and microbiological parameters of the developed products in the

storage process and the impact on these changes of different types of packaging. As a result, it was established that the guaranteed shelf life of grain bread in packaging with a biaxially oriented polypropylene film is 6 months at a temperature of 18 ± 2 °C and a relative humidity of 70...75%.

4. Conclusion

1. On the basis of marketing research, the expediency of developing and expanding the range of new grain bread of the improved quality, enriched with vegetable additives, has been justified.

2. On the basis of methods of mathematical modeling the optimum mass fractions of plant components and table salt as components of grain bread have been justified.

3. On the basis of experimental studies it was found that the inclusion of additives in the composition of bread makes it possible to obtain wellness products with high biological value and antioxidant activity. They can be recommended both in mass and in preventive nutrition for consumption by people who suffer from metabolic disorders and obesity.

4. Guaranteed shelf life of grain bread at a temperature (18 ± 2) °C and relative humidity of 70...75% is 6 months.

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