Journal homepage: www.fia.usv.ro/fiajournal
Journal of Faculty of Food Engineering,
Ştefan cel Mare University of Suceava, Romania
Volume XIII, Issue 4- 2014, pag. 365 - 371

MEDICAL AND BIOLOGICAL ESTIMATION OF GRAIN SMALL LOAVES ON THE BASIS OF WHOLE WHEAT GRAIN WITH THE INCLUSION OF VEGETABLE ADDITIVES

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Received November 28th 2014, accepted December 29th 2014

Abstract: *The results of medical and biological estimation of grain small loaves with the inclusion of vegetable additives (Silybum mariánum and green tea extract) are presented in the article. From the analysis of medical and biological data investigations on new grain small loaves, it is obvious that they possess liver-protecting action, therefore they can be recommended both in mass and in prophylactic nutrition of people suffering from diseases of endocrine system, disorder of metabolism, obesity.*

Keywords: *nutrition, medical and biological estimation, grain small loaves, vegetable additives, whole wheat grain*

1. Introduction

Grain products are the most important group of products in the world population's nutrition and are included as the obligatory component of its daily diet. At the expense of application of grain products in nutrition, demand in proteins is supplied up to 40 %, in carbohydrates – up to 60 %, in mineral substances – up to 30 %, in vitamins of group B – up to 40 % and in a man's energy – up to 50 %. In the diet the share of grain products makes up 40–45 % on average from the general diet. It testifies to an especially significant role of grain products in a man's nutrition [1].

In spite of the significant application of grain products in nutrition, their food and biological value is unbalanced by the main food substances [2]. It's stipulated by the fact that food value of grain products depends, to a large extent, on the degree of macro- and micronutrients of the initial grain being preserved in them. In the traditional approach to the grain processing, aimed at maximum removing of seed-coats and obtaining the flour of the top quality, the content of healthy components inevitably decreases. Furthermore, this process continues under the influence of the technological parameters at all stages of production and storage of products. In the process of the technological processing of the raw materials into food products, the significant amount of micronutrients is lost. During grinding of grain into flour, the most part of them is removed with the seed-coats. The flour of the top quality is much poorer in vitamins and minerals, than the flour of lower grades. At the stage of production of finished products, further decrease of content of physiologically valuable substances, in particular vitamins B_1, B_6, PP, magnesium, potassium, phosphorus, iron, occurs.

Increase in food value and concentration of physiologically functional substances of grain products, can be provided by two ways:

1. Preservation of seed-coats and aleurone

layer, containing the largest amount of micronutrients and biologically active substances of grain;
2. Enrichment of the products with functional ingredients in the process of their production.
The first method provides application of food products on the basis of the whole grain – whole grain bread, grain small loaves, flakes, cereals from unground grain, as well as products from coarse-ground flour.
The second method is connected with the inclusion of vitamin and mineral complexes, vegetable additives, sources of food fibres, prebiotics, phospholipides, proteins and other enriching ingredients into flour, cereals or finished products.
One of the topical directions is application of products on the basis of whole grain in a man's nutrition. The whole-grain food is rich in vitamins, minerals and cellulose, that's why it can be a good choice for people, suffering from cardiovascular diseases, diabetes, obesity and other diseases, caused by the unhealthy diet. Medical and biological research, carried out in the clinic of Harward School of public catering, testify that for the people, suffering from the II-nd type diabetes and using a great amount of the whole-grain products, the risk of death from cardiovascular diseases has decreased by 35% [3].
The scientists of London Imperial College and University of Leeds, as a result of the carried out research, have stated, that daily consumption of 10 grams of cellulose reduces chance of intestine tumour appearance by 10%, and the additional 90 grams of whole-grain products a day reduced the risk of the disease up to 20% [4]. Consumption of whole-grain products can help the patients to reduce the increased blood pressure. As a result, the risk of occurrence of other diseases, such as a heart infarction, a cerebral thrombosis or a stroke, a heart asthenia, can be reduced. According to the researchers, actually, the matter is in vegetable ingredients, which are included in the composition of uncleaned whole-grain products. Worthless substances, magnesium, potassium, calcium, and especially antioxidant substances in the husks, have a beneficial influence on blood vessels properties [5]. The researchers of Harward University in the USA have confirmed the research of the English scientists, who discovered, that the consumption of the products on the basis of whole grain, contributes to reduce of the high blood pressure [6].
The investigations, carried on with the animals, have shown that application of products from cleaned cereals in contrast to whole-grain products, can cause increase in adipose tissue formation, even if the total energy consumption doesn't change and the weight of the body remains constant [7]. On the basis of the carried out medical and biological research it has been stated that whole-grain products, which possess low glycaemic index, cause a feeling of satiation and shorten the consumption of energy, this they contribute to a weight decrease [8].
The investigations of the American scientists, made from 1984 to 1996, (74091 women were under observation) with the aim of establishment the intercommunication between consumption of whole-grain products and weight changing, development of obesity among women of middle age, have shown that weight gaining is in inverse dependence on consumption of whole grain products and in direct dependence on consumption of cleaned cereals and so, it proves distinction between whole-grain products and cleaned cereals for solving the problem of checking the weight [9].
Besides medical and biological investigations in the field of influence of

whole-grain products on the condition of a man's health, the marketing research is carried out with the aim of revealing consumers' preferences concerning the given products. The research, carried out in three European countries of Great Britain, Italy and Finland testify that nowadays consumers care about their health more and prefer the products on the basis of ground whole grain [10, 11]. In Ukraine the marketing investigations of the customers' preferences during choice of grain products, which also testify that a modern customer orients himself, first of all, in the products of sanitary purpose, namely, the products, obtained on the basis of the whole grain, grain products, enriched with different kinds of natural enriching additives, have been conducted [12].

2. Material and methods

Nowadays, in Odessa National Academy of Food Technologies, the research in the field of working out the recipes and complex merchandising estimation of the products quality on the basis of a whole grain, namely grain small loaves with the inclusion of vegetable additives *(Silybum mariánum* and green tea extract), the inclusion of which stipulates improvement of organoleptic indices of small loaves quality, giving additional prophylactic properties and extension of storage terms of the finished product.

The given products are received on the basis of a whole grain according to the special technology, in spite of all this they do not contain residual products of fermentation and are fully ready for consumption. Small loaves refer to low-calorie products, though their calorie content doesn't differ very much from that of ordinary bread. The calorie content of small loaves makes up approximately 300 kcal by 100 grams of the product. However, they contain so called «slow» carbohydrates, which are slowly assimilated by a man's body and together with this they preserve the feeling of satiation for a long time. Physiological value of grain small loaves is determined by the ability to influence digestive, nervous, cardiovascular systems of a man. For example, grain small loaves contain vitamins of B-group, which normalize work of the nervous system. Due to the cellulose small loaves are able to improve the condition of our intestine, remove slags from our organism, regulate work of a gall-bladder and contribute to its cleaning. At the expense of the additives which are included in the small loaves recipe, the additional. Volume of minerals and vitamins, necessary for our organism, appears. The vitamins, which this product contains, increase metabolism of carbohydrates and fats, and macro- and microelements maintain healthy condition of the cardiovascular system, provide optimum acid-and-alkaline balance of the organism. Inclusion of the vegetable additives into a composition of small grain loaves from the wheat whole grain, gives an opportunity of their usage in mass and prophylactic nutrition, which it's nessary to estimate from the point of view of medical and biological research.

3. Results and discussion

The aim of the work was to conduct medical and biological research of small loaves from wheat whole grain with inclusion of vegetable additives, as well as substantiation of the possibility of using them in the prophylactic nutrition of the population. For this, their medical and biological estimation in the conditions of «in vivo» on the laboratory animals (white rats of Vistar line) has been conducted. The research was conducted on the basis of the laboratory of Odessa State Institute

of stomatology of the Academy of Medical Sciences of Ukraine. For every investigation, the experimental animals were fed with a special mixed fodder, in the composition of which a control or experimental sample of grain small loaves 10 % in number from the total mass of the diet, was included.

Biological investigations of the small loaves were conducted on 35 white rats (males, 4 months, average living mass 250 g), which were distributed into 5 groups: I group – intact group of rats (norm); II group – rats with the triple pathology (high-fat diet + AIDS+ dysbacteriosis), subsequently «pathology»; III group – pathology + grain small loaves without inclusion of biologically active substances; IV group – pathology + grain small loaves, containing fine-crumbled up silybum mariánum (lat.); V group – pathology + grain small loaves, containing green tea extract. High-fat diet was received by adding some 15 % oil to the mixed fodder. AIDS was created by introducing the cytostatic of cyclophosphane in a dose of 25 mg/kg in a day during 20 days. Dysbacteriosis was caused by introducing the antibiotic of lincomicine in a dose of 60 mg/kg with drinking water every day during 5 days. Euthanasia of the animals was carried out on the 21-st day during thiopenthal anaesthesia (20 mg/kg) by the total blood-letting from the heart.

Blood serum was obtained and a part of liver was slashed to pieces. In the blood serum the following «liver» markers were determined: the content of bilirubin, activity of alaninetransaminase and activity of alkaline phosphatase.

In the liver homogenate (50 mg/ml 0,05M tris-HCl-buffer pH 7,5), the level of inflammation markers was determined: activity of elastase, content of malon dealdehyde, activity of urease (index of microbe sowing), activity of lysozyme (marker of non-specific immunity), activity of antioxidant enzyme of catalase. According to the correlation of catalase activity and content of malon dealdehyde, the antioxidant – prooxidant index was calculated, and by the correlation of relative activities of urease, the degree of dysbacteriosis, according to Levitskiy, was calculated [13]. In figure 1 the results of determining the level of «liver» markers in the blood serum are presented.

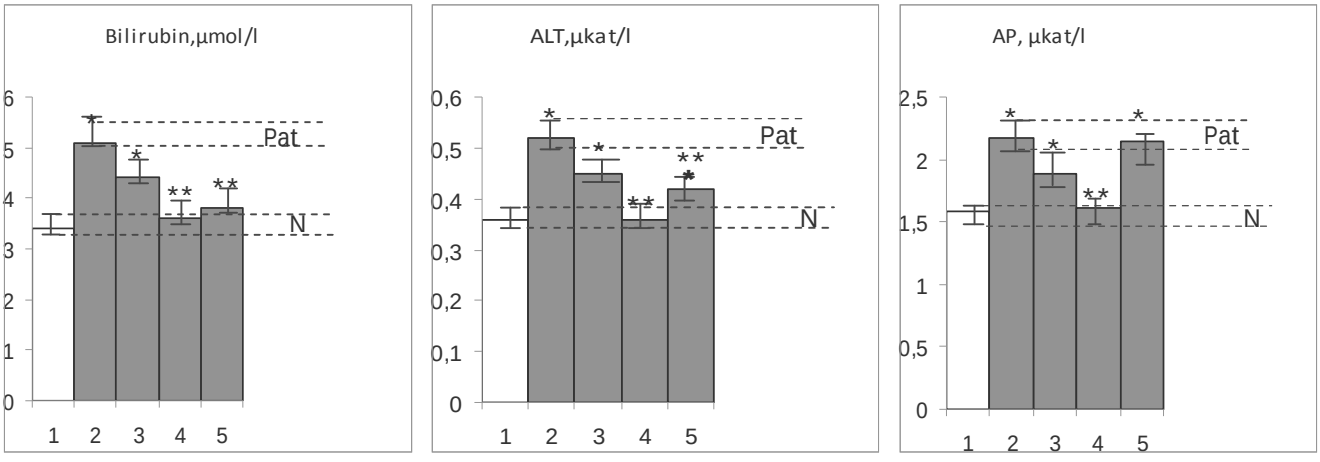

Fig. 1 Influence of food additives on the level of «liver» markers in the rats' blood serum
(1 – norm, 2 – pathology (P), 3 – P + small loaves, 4 – P + small loaves with silybum mariánum (lat.), 5 – P + small loaves with green tea), * – $p<0.05$ in comparison to graph № 1; ** – $p<0.05$ in comparison to graph № 2

From the obtained data, it can be seen that during modelling of the triple pathology (high-fat diet, AIDS and dysbacteriosis) all three «liver» markers really increase their level. Feeding rats with small loaves without dietetic additives decreases a little the level of the markers (however, in all cases $p>0.05$). At the same time, small loaves, containing finely crumbled up *Silybum mariánum*, really reduce the level of liver markers practically to the norm, and it testifies to high liver protecting efficiency of finely crumbled up *Silybum mariánum*. It's known, that the leaves of *Silybum mariánum* contain flavolignans [14], which are widely used in medicine in a number of liver protectors.

As for the group of animals, which received small loaves with the additive of green tea extract, the level of bilirubin and activity of alaninetransaminase really reduce.

In Fig. 2 the results of determining activity of elastase in the liver tissue have been given. From it we can see that increased activity of inflammation marker significantly reduces during small loaves action, even if they don't contain dietetic additives.

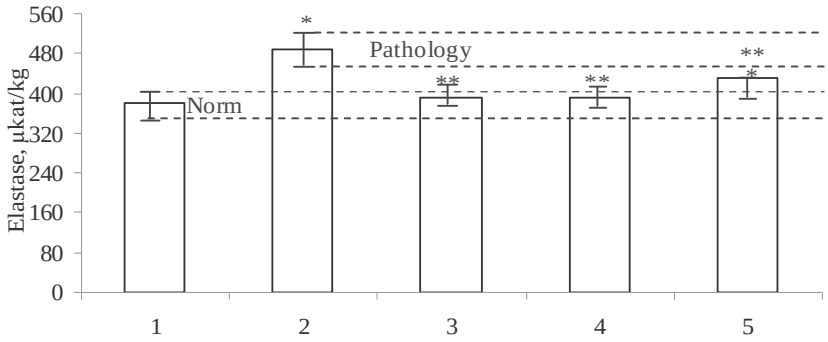

Fig. 2 Influence of food additives on the activity of elastase in the rat's liver with the combined pathology
(1 – norm, 2 – pathology (P), 3 – P+small loaves, 4 – P+ small loaves with silybum mariánum (lat.), 5 – P+small loaves with green tea), * – $p<0.05$ in comparison to graph № 1; ** – $p<0.05$ in comparison to graph № 2

The level of the second marker of inflammation, malon dealdehyde, reduces in rats' liver, which received small loaves with the additive of finely crumbled up silybum mariánum (lat.) (fig. 3).

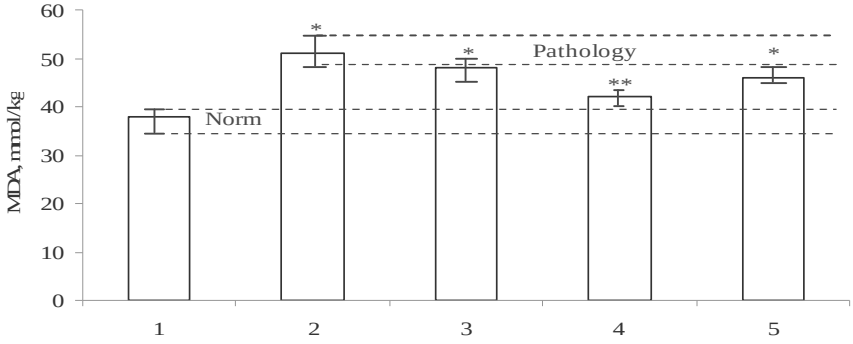

Fig. 3 Influence of food additives on content of malon dealdehyde in rats' liver with combined pathology
(1 – norm, 2 – pathology (P), 3 – P+small loaves, 4 – P+ small loaves with silybum mariánum (lat.), 5 – P+small loaves with green tea), * – $p<0.05$ in comparison to graph № 1; ** – $p<0.05$ in comparison to graph № 2

In table 1 the results of determining activity of urease and lysozyme in rats' liver are given.

Table 1
Influence of food additives on the activity of urease and lysozyme in rats'liver with combined pathology (all groups consist of 7 rats each)

№	Groups	Urease, μkat/kg	Lysozyme, unit/kg
1	Norm	0.20±0.05	167±15
2	Pathology (P)	0.97±0.11 p<0.001	62±20 p<0.001
3	P + small loaves	83±10 p<0.01 p_1>0.3	102±10 p<0.01 p_1<0.05
4	P + small loaves with silybum mariánum	73±9 p<0.01 p_1>0.05 p_2>0.1	103±10 p<0.01 p_1<0.05 p_2>0.8
5	P + small loaves with green tea extract	75±11 p<0.01 p_1>0.05 p_2>0.5	83±10 p<0.01 p_1>0.3 p_2>0.1

Note: p – in comparison to group №1; p_1 – in comparison to group №2; p_2 – in comparison to group №3

From the obtained data we can see that during pathology in liver, activity of urease significantly increases (almost by 5 times!) and it testifies to increase of microbe sowing of this organ. Using small loaves decreases activity of urease, to a greater degree with the additive of finely crumbled-up silybum mariánum (lat.).
The results of determining the degree of dysbacteriosis in liver (fig. 4) show, the degree of dysbacteriosis increases by 12 times and really decreases during feeding with small loaves with vegetable additives.

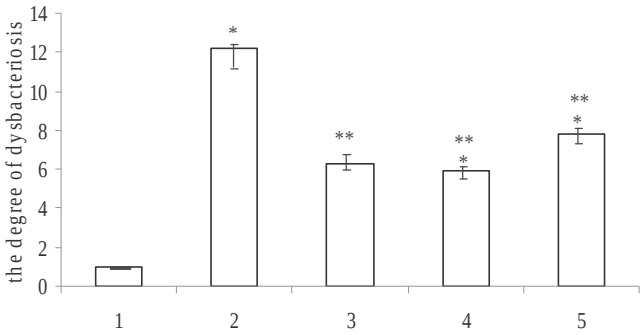

Fig. 4 Influence of food additives on the degree of dysbacteriosis in rats' liver with the combined pathology
(1 – norm, 2 – pathology (P), 3 – P+small loaves, 4 – P+ small loaves with silybum mariánum (lat.), 5 – P+small loaves with green tea), * – p<0.05 in comparison to graph № 1; ** – p<0.05 in comparison to graph № 2

In table 2 the results of determining the activity of catalase and antioxidant-prooxidant index are given.

Table 2
Influence of food additives on activity of catalase and antioxidant-prooxidant index (API) in rats'liver with combined pathology (all groups consist of 7 rats each)

№	Groups	Catalase, μkat/kg	API
1	Norm	5.93±0.20	1.57±0.08
2	Pathology (P)	5.78±0.09 p>0.03	1.14±0.09 p<0.005
3	P + small loaves	5.82±0.14 p>0.3 p_1>0.6	1.21±0.10 p<0.05 p_1>0.3
4	P + small loaves with silybum mariánum	5.92±0.25 p>0.09 p_1>0.3 p_2>0.3	1.44±0.11 p<0.4 p_1<0.05 p_2>0.05
5	P + small loaves with green tea extract	5.80±0.05 p>0.3 p_1>0.8 p_2>0.8	1.27±0.08 p<0.05 p_1>0.3 p_2>0.4

Note: p – in comparison to group №1; p_1 – in comparison to group №2; p_2 – in comparison to group №3

4. Conclusion

Enriched small loaves of the cereals are the products of the new generation. That's why growth of production and development of scientifically grounded new types of grain products in Ukraine becomes necessary for our society. The development of the new compositions at the expense of introducing the additives of vegetable origin into the composition, will allow to increase their food and biological value as well as to balance the correlation of the main food substances at most.

Analysing the data of medical and biological investigations of the new grain small loaves from the wheat whole grain with inclusion of vegetable additives, it was determined that they possess liver protecting activity, that's why they can be recommended both in mass and in prophylactic nutrition of the population.

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