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The usage of the whole grain spelt flour in the cracker`s technology

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Abstract. Nowadays there has been a revival of interest in ancient crops, such as spelt wheat, which differs from modern varieties of wheat with more balanced chemical content. The effect full replacement of modern wheat flour with whole grain spelt flour on the cracker`s quality was studied. Addition of the spelt flour leads to a high sensory characteristics formation of the product. Ancient wheat flour based samples characterized with more rich color and more intense taste and aroma. The usage of spelt flour increased the product`s ability to water absorption (145 %), acidity (2.0 degree), which are in the accordance with standard requirements.

The results have shown the positive effect on the nutritional value of the final product. The highest protein content (16.44 g/100 g) was obtained for the enriched samples, there were also an increase in micronutrients content – Fe (by 27.8 %), K (by 22.9 %), B5 (by 83.6 %). In vivo studies have proven that consumption of the products based on whole grain spelt flour effectively prevented the development of inflammation and dysbiosis processes. Obtained results indicate the effectiveness of full replacement modern wheat flour with whole grain spelt flour for the cracker`s with high nutritional value production.

Keywords: spelt wheat, whole grain flour, crackers, quality, high nutritional value.

1. Introduction

Nowadays the increasing consumer`s preferences for nutrient-enriched food products is observed. Due to this investigators and manufacturers are strongly interested in the used raw material base expansion. There has recently been a revival of interest to ancient varieties of wheat, such as spelt. It is known that spelt wheat is suitable for growing without the use of pesticides, which is challenging for the modern species of wheat, and its unrefined flour possesses valuable nutritional potential due to its chemical content [1]. Spelt wheat is a source of easily digestible form of protein and dietary fiber [2]. Its grain contains wide range of biologically active nutrients, which characterized with antioxidant properties and high solubility level, which provide their faster assimilation in organism [3,4]. The consumption of spelt wheat based products positively effects on the immune system, reduces the cholesterol level and regulates blood coagulation processes [5].

The spelt flour is used in the value-added flour-based products technologies. The obtained results confirmed that the mixture of spelt and bread wheat flour is suitable for the baking. The most acceptable spelt flour mass fraction is 15 % in the bread recipe. Also the ancient variety of wheat is feasible to use in the pasta and extruded products technologies. These products are characterized with the increase content of the soluble and insoluble fiber compared with the control samples [5,6].



At the same time the differences in the chemical content of spelt compared with modern wheat provides the difference in technological properties of the ancient wheat flour. This leads to the need to justify the choice of the pastry type and to the effective technological solutions search to prevent a decrease of the final products quality based on the whole grain spelt flour instead of the modern wheat flour (MWF). Due to this the problem of spelt usage in flour-based products technologies is still actual. The aim of this research was to evaluate the efficiency of the modern wheat flour full replacement with whole grain spelt flour in the cracker`s technology.

2. Materials and methods

The MWF (T-550 quality) used for cracker`s manufacturing was produced by Kulindor bakery manufacturer (Ukraine), whole grain spelt flour (organic certified) –TM “Ecorod” (Ukraine). The crackers were produced in laboratory, used 2-stages dough`s preparation (sourdough and dough). The control samples were prepared based on modern wheat flour; the enriched samples–by replacing the MWF with 100 % whole grain spelt flour (WGSF). Ingredients for each recipe are listed in table 1, water content was according to the calculation based on the moisture content of the recipe.

Table 1. Cracker`s recipe.

Ingredients (g)	MWF	WGSF
Whole wheat grain flour	1008.30	-
Whole grain spelt flour	-	1008.30
Fresh yeast	32.76	32.76
Sugar	22.69	22.69
Lactic acid	2.65	2.65
Salt	15.15	15.15
Sodium bicarbonate	6.09	6.09
Ammonium carbonate	4.54	4.54

The physico-chemical parameters of crackers were studied by generally accepted methods in Ukraine. The moisture content was determined by drying method (DSTU 4910:2008) and titratable acidity was defined as the amount of 0,1N NaOH solution (mL) used to neutralize 5 g sample weight homogenized with 50 ml of distilled water (DSTU 5024:2008). The ability to water absorption was measured by the extent of cracker`s swelling during 4 min [7,8]. Sensory evaluation was performed by ten trained panelists. Sensory evaluation was done using the preference ranking test method [10], in which the pre-coded samples were given scores from a five-point scale where 1 is extreme dislike and 5 is extreme like; an overall quality score was figured out as average of the five evaluated sensory attributes. The panelists considered the following quality attributes: appearance, texture, colour, aroma and taste. The tests were performed under daylight room conditions. Nutrition and energy values were calculated using a specific Excel spreadsheet according Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers.

The *in vivo* study was performed on a three groups of rats: 1–control, 2–modeling of dysbiosis, 3–fed with elaborated samples group with modeled dysbiosis. All experiments were performed in triplicate. All data were statistically analysed by analysis of variance (ANOVA) and Fischer test. Significance was accepted at $p < 0.05$.

3. Results and discussion

One of the main difference of spelt flour compared with modern bakery wheat flour is higher yield of wet gluten and weaker gluten structure [9]. The investigation of the technological characteristics requirements for the wheat flour used in the pastry production is shown that cracker`s technology

requires the flour with weak gluten usage. Due to this the whole grain spelt flour was suggested to use in cracker`s recipe. The obtained results have shown that WGSF adding in the cracker`s recipe didn`t lead to significant differences with quality compared with the control (table 2).

Table 2. The physico-chemical parameters of crackers.

Parameter	MWF	WGSF
Moisture (%)	10.6	10.7
Acidity, degree	1.6	2.0
Ability to water absorption (%)	132	145
Density (kg/m ³)	700	650

The research of ancient wheat flour influence on moisture content of crackers indicates that it remained within the requirements of the standard [9]. The acidity increase was observed for the spelt-based samples (WGSF- 2.0 degree; MWF - 1,6 degree) due to the higher acidity of used whole grain spelt flour compared with MWF. It was found that the product`s ability to water absorption for spelt wheat sample has increased by 9.8 % compared with the control. This is due, probably, to the more porous crackers structure formation through the higher gas-retention ability for the yeast semi-finished products based on ancient crop flour during the dough maturation stage.

Use of the spelt flour has led to a high sensory characteristics formation of the final product. Ancient wheat flour based samples were characterized with a tender, non-brittle texture, more rich color and more intense taste and aroma compared the control (figure 1).

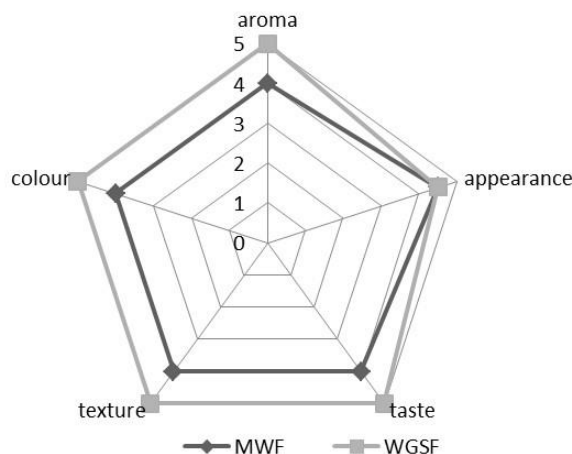


Figure 1. Sensory evaluation of crackers.

The assessment of the product nutritional value has shown that the protein content increased by 19.5 % in products based on WGSF compared to the control. Obtained data is in agreement with Frakolaki et al. [1] results about the spelt flour increased protein content. These samples were also characterized with reduced by 3.5 % of the fast digesting carbohydrates content, increased content of dietary fiber. It is important to note an increase in micronutrients content – Fe (by 27.8 %), K (by 22.9 %), B₅ (by 83.6 %) for the developed crackers (table 3). Comparing obtained data with the recommended daily intake level of the macro- and micronutrients confirmed the positive effect of the ancient wheat crop flour on the nutritional value of the final product which complied with Kyptova M et al. [6].

Table 3. Nutritional value of the crackers.

Parameters	per 100 g of final product		
	MWF	WGSF	Daily intake level (for the WGSF), %
Protein, g	10.9	13.5	18.0
Fat, g	2.1	2.3	3.0
Carbohydrates, g:			
total	69.8	66.7	14.8
dietary fibre	8.9	10.0	39.9
Ash, g	2.7	3.6	
Vitamins, mg:			
B ₁	0.36	0.39	26.0
B ₂	0.22	0.14	7.0
B ₅	0.18	1.12	9.3
PP	4.92	6.59	41.2
Minerals, mg:			
Na	654.0	686.2	52.8
K	285.8	370.7	14.8
P	356.8	375.6	31.3
Fe	3.0	4.2	28.0
Mg	98.0	125.15	27.8
Energy value, kcal	318.6	307.7	13.4

The physiological properties were determined with catalase and elastase activity levels, which are inflammatory markers, in rat's blood serum. The catalase activity level was 0.28 ± 0.01 mkat/l for the 2 rat's group (with dysbiosis) and 0.41 ± 0.04 mkat/l for the 3 group (feeding with WGSF products). The obtained data have indicated the ability of the developed products to prevent a decrease in the antioxidant system activity after the antibiotic therapy. The consumption WGSF based samples for the rats with modeled dysbiosis has led to a reduction in the activity of elastase in their blood serum, the level of which corresponded to the values of the control group. This may be an argument supporting the conclusion that the consumption of the enriched samples able to prevent the development of the inflammatory processes in the organism.

4. Conclusions

Results achieved in the study demonstrate that whole grain spelt flour could be a promising ingredient alternative to the modern wheat flour for the cracker's production. The addition of WGSF provides the formation of the high quality characteristics– the cracker's ability to water absorption increased compared with the control, which approve high porous structure formation of spelt crackers. Its positive effect was also confirmed in the sensory evaluation. Crackers based on the ancient wheat flour have significantly higher nutrients content than the control. The chemical composition of the spelt flour produced an improvement in the protein and dietary fiber content, increased minerals–Fe, K and vitamin B₅ in the final product. Based on the obtained *in vivo* study results it should be mentioned that the consumption of developed products could be effective for the risk reduction of the antibiotic therapy negative effects.

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