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CHEMICAL COMPOSITION OF COTTAGE CHEESE ENRICHED WITH FLAKES FROM GERMINATED WHEAT GRAINS

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Abstract

Last time demand for innovative, healthy and safety food products increase. Cottage cheese is popular dairy product in Latvia. Traditionally it is nutritionally rich in protein, calcium, B group vitamins, but not in dietary fiber. However grains and their products, like flakes from germinated wheat, have a high amount of vitamin E and C, niacin, mineral substances, microelements and dietary fiber. Therefore the aim of the current research was to produce cottage cheese with flakes from germinated wheat grains and to evaluate quality of final product. For the experiments non pasteurized skimmed milk, starter culture and flakes from the germinated wheat grains were used. The cottage cheese was made by traditional technology. The flakes were produced from biologically activated wheat grains and treated with ozone. Ready wheat grain flakes were added to the prepared cottage cheese during production. Quality parameters of ready product were controlled using standard methods. As control sample cottage cheese without additives were analyzed. The optimal proportion of flakes to cottage cheese was 3%, it gives possibility significantly increase content of α and γ tocopherol, B_6 vitamin, and fiber in the final product.

Key words – *biologically activated grains, cottage cheese.*

1. INTRODUCTION

Cottage cheese is one of the most popular products in Latvia. The protein content in it ranged from 14-19%, it contain essential aminoacids, like a phenylalanine, leucine, isoleucine, histidine, lysine, methionine, threonine, tryptophan, valine, as result cottage cheese is added to dietetic products group (Твердохлебов, 2006, Ciprovica, Ozola, 2002) . Cottage cheese curds can be manufactured by the acid coagulation of skim milk, typically through starter culture (*Lactococcus lactis* un *Lactococcus cremoris)* activity Горбатова, 1997; Горбатова, 2004).

Latvian milk processing enterprises have different types of cottage cheese and cottage cheese products: with chocolate, fruits, jams and others. But cottage cheese with grains or grains' products is not available on the Latvian market. According to the literature grains can be a good source of fiber, vitamins and microelements, as well new sensory properties of the product (Benefits of wheat, 2011; Kunkulberga, 2010). Comparing different types of grain products particularly should be highlighted biologically activated or germinated grains.

According to the literature, the activity of enzymes increases during germination: endohydrolase enzymes (α; β-amylases), proteolytic enzymes, diphenoloxsydase, and catalyse were activated. (Казаков, Кретович, 1989; Hugh *et al.*, 1998). During the activation time dietary fibre content has increased. The amount of vitamin B_2 has increased by 54.5%, vitamin E content has grown 6.5 times, the content of niacin has increased 1.3 times. Vitamin C was not found in inactivated grain samples, but during the activation process by means of biochemical reactions it was synthesized - 71.0 mg kg^{-1} in

wheat grain. Total content of amino acids has decreased by 17.4% in wheat grain during the grain activation time up to 24 hours (Rakcejeva, 2006; Rakcejeva, 2007).

The results of researches show that biologically activated grain is a healthy product and, if such grain is used in conventional food, it would intensify metabolism, strengthen immunity, compensate deficiency of vitamins and mineral substances, and normalize acid and alkali balance (Иванов *и др*., 2005).

At the same time enriching cottage cheese with flakes from biologically activated wheat grains increases risk factor to contaminate final product with different types of microorganisms. Some researchers offer to use grains treatment with ozone for insuring high quality food and for inactivation of microorganism or slowing they grow (Mendez, 2003). Ozone (O_3) is a strong oxidant recognized since 1997 as a generally recognized as safe substance and used in a number of applications in the food industry for destruction or detoxification of chemicals or microorganisms. These applications include the surface decontamination, storage and preservation of perishable foods as well as water or manufacturing equipment and packaging sterilization (Desvignes et al., 2008; Gonçalves, 2009). Ozone in gaseous or aqueous form is reported to reduce levels of the natural microflora, as well as bacterial, fungal and mould contamination in cereals and cereal products, including spores of *Bacillus, Coliform bacteria, Micrococcus, Flavobacterium, Alcaligenes, Serratia, Aspergillus and Penicillium*. Ozone is not universally beneficial and in some cases may promote oxidation degradation of chemical constituents present in the grains. Surface oxidation, discoloration or development of undesirable odours may occur from excessive use of ozone. However, higher ozone concentrations (>50 ppm) cause considerable oxidative damage to cereal grains (Tiwaria et al., 2010). In a three-year study carried out at a rural site in Switzerland, spring wheat was exposed to different levels of ozone (O_3) in open-top-field chambers from the two-leaf stage until harvest. Grain recovered from the different treatments was analyzed for minerals (Ca, Mg, K, and P), starch, protein, amino acids and α-tocopherol, in order to investigate the effect of O_3 on grain composition. As a result no effect of O_3 on the content of α-tocopherol and on the essential amino acid index of the protein was observed. It is concluded that compositional changes in wheat grain in response to O_3 are minor, and that ambient O_3 is not likely to cause important changes (Fuhrer et al., 1990).

Therefore the aim of the current research was to produce cottage cheese with flakes from germinated wheat grains and to evaluate quality of final product.

2. MATERIAL AND METHODS

For the experiments raw skimmed milk, starter culture and flakes from germinated wheat grains (breed *Zentos*), obtained from LUA research station „Petera lauki" were used. The cottage cheese was made by traditional technology. The flakes were produced from biologically activated wheat grains treated with ozone. Ready wheat grain flakes were added to the prepared cottage cheese during production.

Quality parameters of products were controlled using standard methods (see Table 1).

As control sample cottage cheese without additives were analyzed.

Before addition to the cottage cheese wheat grains were covered with water (40 ^{0}C) for two times, then grains were aged at 20 ± 2 °C, this was grains biological activation period.

Flakes from biologically activated grains were made with equipment *"havos" El Flocko*. Then flakes were dried in convection drier *"Memmert" D 91107 Schwabach*. at 55 ±5 C°

Flakes from biologically activated wheat grains were treated with ozone with *BNP Ozone Technology CO.LTD.* ozone generator.

Flakes were treated in two ways:

1. covered with ozone water;

2. covered with ozone gas.

Table 1. Methods used in the research

Product	Parameter	Standard
Cottage cheese	fat content	Gerber method
	moisture	LVS EN ISO 5537:2004
	acidity	LVS ISO 6091:2003
Cottage cheese Wheat Cottage cheese with flakes	Protein content	LVS ISO 8968-5:2002
	E vitamin content	liquid chromatography with high performance E vitamin detection
	Tocopherols content	LVS EN 12822:2001
	B_2 vitamin content	liquid chromatography with high performance B2 vitamin detection LVS EN 14152:2003
	B_6 vitamin content	liquid chromatography with high performance B6
	B_{12} vitamin content	LVS EN 14164:2008
	Aminoacids concentration	LVS ISO 13903:2005

The different concentrations of ozone were used: 0,2 ppm, 0,5 ppm, 1,0 ppm un 2,0 ppm, and regimes: 1 min, 3 min un 6 min. After microbiological evaluation the best way of treatment was ozone gas, concentration 2 ppm and time 6 min.

Descriptitive statistics were carried out to determine the differences of cottage cheese with and without flakes from biologically activated wheat grains by Microsoft Windows for SPSS software packages.

3. RESULTS

One of the research tasks was to determine proportion of flakes in the final product. After sensory evaluation of the product the optimal proportion was detected as 3% from cottage cheese mass.

Fig.1. Cottage cheese with flakes from biologically germinated wheat grains.

The chemical composition of cottage cheese is given in the Table 2. The cottage cheese was produced with normal chemical composition: high protein 16.38%, and low fat content 0.50%.

Table 2. Chemical composition of cottage cheese

Parameter	Value	Regulation rules [1]
Fat content, %	0.5	0.5
Protein content, %	16.38	16-18
Moisture, %	62.90	Not more than 80%
Acidity, ^{0}T	210	210

According to the data from literature concentration of tocopherol in milk is very low (see Table 3).

Table 3. Concentration of tocopherol in products

Products	alfa tocopherol, mg kg^{-1}	gamma tocopherol, mg kg^{-1}
Cottage cheese	0.01±0.0001	0.07±0.004
Flakes from wheat grains	6.68±0.330	4.30±0.220

The concentration of α (668 times) and ɣ tocopherol (61 times) is significantly higher ($p<0.05$) in flakes from biologically activated grains, comparing with cottage cheese. Flakes addition to the cottage cheese can be a good possibility to increase these vitamins concentration in ready product.

[1] MK noteikumi Nr. 97 Noteikumi par klasifikācijas, kvalitātes un marķējuma prasībām piena produktiem un saliktiem piena produktiem, Rīgā 2011.gada 1.februārī (prot. Nr.7 23.§)

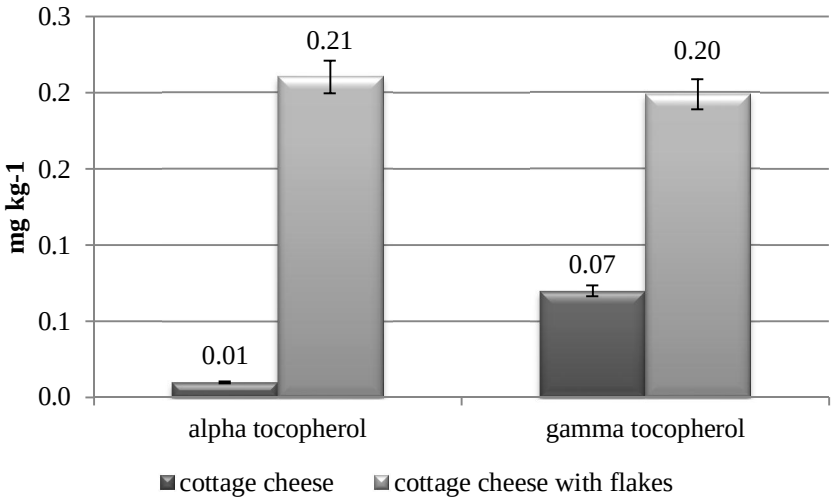

Fig. 2. Concentration of α and ɣ tocopherol in cottage cheese with and without flakes.

Concentration of alpha and gamma tocopherol in cottage cheese and in cottage cheese with flakes is given in Fig. 2. In the final product (cottage cheese with flakes) it is possible significantly increase ($p<0.05$) concentration of these vitamins. The concentration of α tocopherol increase 21 times, but ɣ tocopherol 2.9 times. It means that addition of flakes from germinated wheat grains increases concentration of total tocopherol in final product.

The concentration of B group vitamins was evaluated as in flakes from germinated grains, as in cottage cheese (see Table 4).

Table 4. Concentration of vitamins B_2, B_6, B_{12} in products

Product	**Concentration of vitamin**		
	B_2, mg $100g^{-1}$	**B_6, mg $100g^{-1}$**	**B_{12}, mkg $100g^{-1}$**
Cottage cheese	0.65±0.03	0.02±0.01	0.10±0.01
Flakes from biologically activated wheat grains	0.54±0.025	0.36±0.01	0.02±0.0001

Comparing B groups' vitamins concentration, the highest was B_2 as in cottage cheese - 0.65 mg $100g^{-1}$, as in flakes - 0.54 mg $100g^{-1}$. The lowest concentration of B group vitamins was B_6 in cottage cheese and B_{12} in flakes.

Comparing cottage cheese and flakes the significantly higher concentration of B_6 vitamin ($p<0.05$) (18 times) was in flakes, but significantly lower (5 times) B_{12} vitamins concentration. Significant difference was not established compared B_2 vitamin concentration in flakes and in cottage cheese. It means that B group vitamins addition differently influences nutritional value of final product.

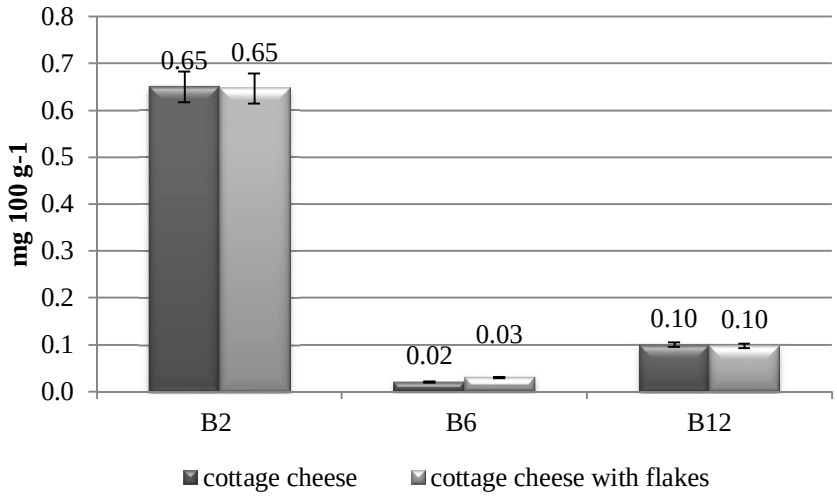

Fig. 3. Concentration of B group vitamins in cottage cheese with and without flakes.

The concentration of B group vitamins in ready product is given in Figure 3.

Comparing with control sample - cottage cheese without flakes – concentration of B_2 and B_{12} vitamin practically was not changed, but concentration of B_6 vitamin significantly increases ($p<0.05$) – 1.5 times in cottage cheese with flakes.

Cottage cheese is reach in proteins and amino acids. Content of amino acids in cottage cheese and in flakes from biologically activated wheat grains is shown in Table 5. It can be observed, that in higher amount of amino acids in cottage cheese are: proline, glutamic acid, leucine, lysine, glutamic acid. In higher amount, comparing to cottage cheese, in flakes from biologically activated wheat grains was glycine and cysteine. Concentration of other amino acids in flakes was lower than in cottage cheese.

Table 5. **Amino acids in cottage cheese and in flakes from biologically activated wheat grains.**

Amino acids	**Cottage cheese, g 100g^{-1}**	**Flakes from biologically activated whet grains, g 100g^{-1}**
valine	**0.34±0.02**	0.13±0.05
leucine	**0.47±0.02**	0.45±0.20
isoleucine	**0.30±0.02**	0.22±0.11
phenylalanine	0.31±0.02	0.33±0.02
cysteine	-	**0.10±0.05**
lysine	**0.44±0.02**	0.21±0.11
arginine	**0.19±0.01**	0.08±0.01
histidine	0.17±0.01	0.20±0.11
aspartic	**0.40±0.02**	0.15±0.02
serine	**0.29±0.02**	0.15±0.02

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glutamic acid	**0.99±0.05**	0.35±0.02
glycine	0.10±0.01	**0.26±0.11**
threonine	**0.27±0.01**	0.23±0.11
alanine	0.20±0.01	**0.22±0.11**
proline	**0.47±0.02**	0.06±0.01
tyrosine	**0.29±0.01**	0.12±0.05
methionine	**0.16±0.01**	0.10±0.05

The content of amino acids in final product is shown in Figure 4. Significant changes between control sample and cottage cheese with flakes from biologically activated wheat grains were not observed. Cottage cheese with flakes can be enriched only with cysteinie, which was not detected in cottage cheese.

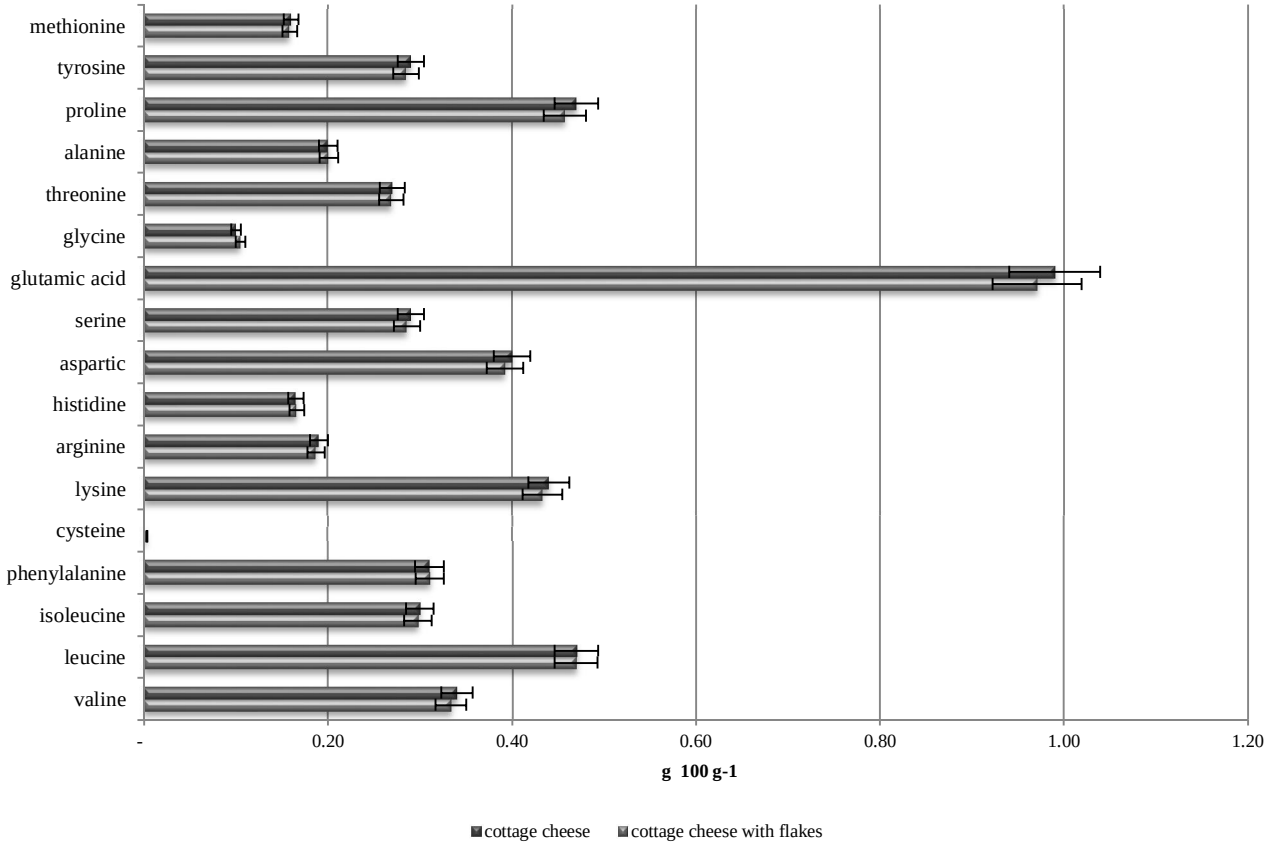

Fig. 4. Content of amino acids in cottage cheese with and without flakes.

Assessing chemical composition and nutritive value of final product, concluded, that addition of flakes from biologically activated wheat grains to the cottage cheese increase concentration of α and ɣ tocopherol, B_6 vitamin, as well enrich with dietary fibbers, and develop new sensory properties of the product.

4. CONCLUSIONS

1. Optimal proportion of biologically activated wheat grains is 3% of cottage cheese mass.
2. Addition of biologically activated wheat grains to cottage cheese significantly increase concentration of alpha and gamma tocopherol accordingly 21 and 2.9 times, concentration of B_6 vitamin 1.5 times.
3. Flakes from biologically activated wheat can be a good possibility for producing functional product with new sensory properties.

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