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# The Chemical Composition of Yoghurt Enriched with Flakes from Biologically Activated Hull-less Barley Grain and Malt Extract

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***Abstract*****—**The influence of flakes from biologically activated hull-less barley grain and malt extract on chemical composition of yoghurt was studied.

Pasteurized milk, freeze-dried yoghurt culture YF-L811 (Chr. Hansen, Denmark), flakes from biologically activated hull-less barley grain (Latvia) and malt extract (Ilgezeem, Latvia) were used for experiments. Yoghurt samples with and without flakes from biologically activated hull-less barley grain and malt extract were analyzed for content of total solids, total proteins, fats, amino acids and riboflavin.

The addition of flakes from biologically activated hull-less barley grain and malt extract allowed increase of nutritional value of yoghurt samples. There was obtained the increase of total proteins ($p>0.05$) and the decrease of fat ($p>0.05$). The presence of flakes from biologically activated hull-less barley grain and malt extract in yoghurt samples provided significant increase of amino acids amount ($p<0.05$) and riboflavin concentration ($p<0.05$).

***Keywords*****—**Chemical composition, hull-less barley grain, malt extract, yoghurt.

## I. Introduction

MILK has been considered as a basic food in many diets. Consumption of dairy products is associated with beneficial health effects beyond pure nutritional value [1]. Milk contains a large variety of essential nutrients like minerals, vitamins and easy digestible proteins with balanced amino acids content. Therefore a majority of people consider milk and its products to be dependable sources of calcium, complete proteins, riboflavin and vitamin A [2]. A variety of fermented milk products are produced throughout the world, among which yoghurt is most popular [3]. Yoghurt is a dairy product produced by bacterial fermentation of milk, which popularity is due to various health claims and therapeutic values [3], [4]. Milk fermentation by lactic acid bacteria generates several peptides, including some with potential bioactivity [5]. Dairy proteins are the preferred choice in special nutrition formulas for building tissues and muscle mass in infants, hospitalized individuals, athletes, dieters and the elderly [6]. However there has been looked for new ways to enrich traditional dairy products with bioactive compounds. One of these is to add cereals, because they are important in the human diet [7]. Cereals contain high amount of proteins, vitamins, dietary fibre, etc. They are essential material for the food industry in the production of functional food ingredients [8]. There is increasing interest in functional foods that are mixtures of plant and animal products manufactured using traditional techniques [9].

Barley is an excellent source of many valuable nutrients because it contains bioactive compounds like dietary fibre, B-complex vitamins, β-glucan, phenolic compounds [10]. Barley have been classified as hull-less and hulled, where hull-less barley have better nutritional value, i.e., more proteins, lipids and soluble dietary fibres [11]. The nutritional value of hull-less barley can be further increased with biological activation, i.e., increased content of dietary fibre, vitamins $B_2$, E and niacin [12].

Barley and malt have been considered as ingredients for production of functional foods due to their concentration of antioxidant compounds furthermore malt should be considered as a new source of natural antioxidant for dietary needs [13]. Therefore, both valuable products – biologically activated hull-less barley grain and malt extract were added to fermented milk in order to increase the nutritional value of the end products. The task of research was to investigate the chemical composition of yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract.

## II. Materials and Methods

Pasteurized milk with fat content 2.5% and the yoghurt culture YF-L811, containing *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* (Chr.Hansen, Denmark) were used for experiments. During the experiments, the culture was stored at -18 $^{o}$C.

Flakes from biologically activated hull-les barley grain (Latvia) in concentration of 5% and malt extract (Ilgezeem, Latvia) in different concentrations (2%, 4% and 6%) were added to milk. The nutrition composition of flakes from biologically activated hull-less barley grain and of malt extract is presented in Table I.

Milk samples with flakes from biologically activated hull-less barley grain and malt extract were inoculated with yoghurt culture and fermented at 43 $^{o}$C for 4 hours. The control sample was prepared without the flakes from biologically activated hull-less barley grain and malt extract for comparing results.

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TABLE I
THE NUTRITION COMPOSITION OF FLAKES FROM BIOLOGICALLY ACTIVATED HULL-LESS BARLEY GRAIN AND MALT EXTRACT, G 100 $G^{-1}$

| | Protein | Fat | Carbohydrate |
|---|---|---|---|
| Flakes from biologically active d hull-less barley grain | 13.53 | 2.70 | 1.84 |
| Malt extract | 4.00 | 0 | 73.00 |

Yoghurt samples with and without flakes from biologically activated hull-less barley grain and malt extract were analyzed for content of total solids by AOAC Method 990.20, total proteins by the Kjeldahl method according to ISO 8968-3 / IDF 20-3, fats by AOAC Method 905.02, amino acids by Method AS/HPLC-MS and riboflavin by AOAC 970.65.

The analyses were performed in triplicate. The results of research were analyzed using the analysis of variance (ANOVA). T-test was applied to compare the mean values, and p-value at 0.05 was used to determine the significant differences.

## III. RESULTS AND DISCUSSION

The nutritional value of products depends on content of total solids. Therefore it is necessary to determine the total solids content for evaluating of products. The changes of total solids content in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract are shown in Fig. 1.

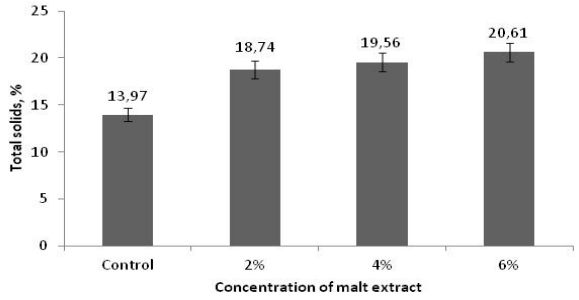


Fig. 1 Total solids content in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract

By adding of flakes from biologically activated hull-less barley grain in concentration of 5% (with total solids content – 88%) and malt extract in concentrations of 2%, 4% and 6% (with total solids content – 60%) there was obtained significant increase of total solids content in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract comparing with control ($p<0.05$). The increase of total solids was determined by 35%-47% in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract. It implies that yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract have higher nutritional value. Therefore there was determined the content of total proteins, fats, amino acids and riboflavin in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract.

Evaluating the content of proteins in yoghurt enriched with flakes from biologically activated hull-less barley grain and malt extract it must be indicated that milk proteins are potential ingredients of health-promoting functional foods targeted at diet-related chronic disease, such as cardiovascular disease, diabetes type II and obesity [14]. Therefore it is significant to increase the content of milk protein during fermentation and total protein content with adding of valuable compound such as cereals in yoghurt. Whereas the tendencies in food industry about fat content in products are contrary, ie., to offer low fat or skimmed dairy products. It is related with overweight and obesity problem globally [15]. Customers have interest in products with low or reduced fat content. Milk fat contains saturated fatty acids increasing serum cholesterol which is considered as a risk factor for coronary heart disease [16]. Therefore it is significant to produce new dairy products with low or reduced fat content. The effect of added flakes from biologically activated hull-less barley grain and malt extract on total proteins and fat content in yoghurt samples is shown in Fig. 2.

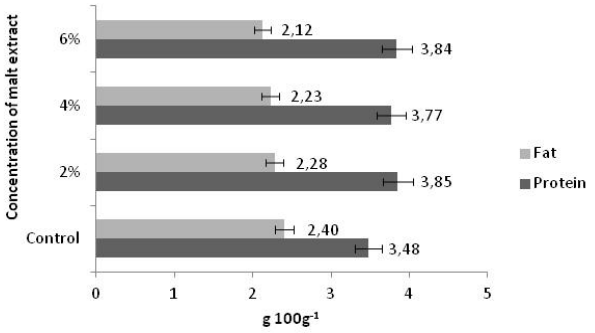


Fig. 2 Fat and protein content in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract

The obtained results have shown that it was possible to increase total protein content and to decrease fat content in yoghurt samples adding flakes from biologically activated hull-less barley grain and malt extract. However the changes of total protein and fat content in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract and control were insignificant ($p>0.05$). The effect of added malt extract in different concentrations on total protein and fat content in yoghurt samples with flakes from biologically activated hull-less barley grain was insignificant, too ($p>0.05$).

Biological value of protein affects the amount of essential amino acids in product. Therefore was investigated the amount of essential and non-essential amino acids in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract (Fig. 3).

Comparing the amount of essential and non-essential amino acids in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract and control, it was apparent that the added flakes from biologically activated hull-less barley grain and malt extract provided the increase of amino acids amount in the product. Furthermore the amount of amino acids in yoghurt samples depended on the concentration of added malt extract. The highest content of essential and non-essential amino acids was established in yoghurt sample enriched with flakes from biologically activated hull-less barley grain and malt extract in concentration of 4% (respectively 1.508 mg $100g^{-1}$ and 10.391 mg $100g^{-1}$).

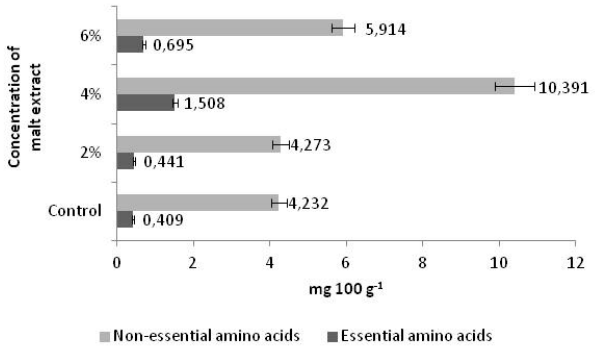


Fig. 3 The amount of essential and non-essential amino acids in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract

The results of dispersion analysis have shown that the significant differences of essential amino acids amount ($p<0.05$) were established among yoghurt sample enriched with flakes from biologically activated hull-less barley grain and malt extract in concentration of 4% and yoghurt samples enriched with flakes from biologically activated hull-less barley grain and mal extract in concentration of 2% and 6%, as well as control. Evaluating the amount of non-essential amino acids there were determined significant differences ($p<0.05$) between yoghurt sample enriched with flakes from biologically activated hull-less barley grain and malt extract in concentration of 4% and yoghurt sample enriched with flakes from biologically activated hull-less barley grain and malt extract in concentration of 2%, as well as control.

Barley grain contains riboflavin in concentration 0.136±0.031 mg $100g^{-1}$ [17]. Furthermore the concentration of riboflavin in hull-less barley grain should be increased by 88.9% during biological activation time [12]. Milk is good source of riboflavin, too [2]. Furthermore during milk fermentation lactic acid bacteria are able to produce B group vitamins, int.al., riboflavin [18]. It appoints that adding of flakes from biologically activated hull-less barley grain and milk fermentation with yoghurt culture should be possibility to increase the concentration of riboflavin in yoghurt samples.

The obtained results showed that by adding flakes from biologically activated hull-less barley grain and malt extract it was possible significant to increase the content of riboflavin in yoghurt samples ($p<0.05$) comparing with control (Fig. 4).

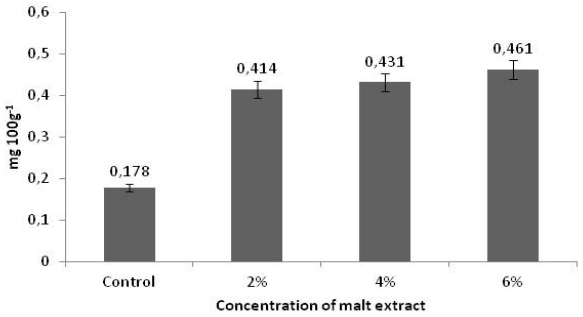


Fig. 4 The content of vitamin $B_2$ in yoghurt samples enriched with flakes from biologically activated hull-less barley grain and malt extract

As well there was significance of the added malt extract concentration. The highest concentration of riboflavin was established in yoghurt sample enriched with flakes from biologically activated hull-less barley grain and malt extract in concentration of 6%. This yoghurt sample significant differed from other samples ($p<0.05$).

## IV. Conclusion

The addition of flakes from biologically activated hull-less barley grain and malt extract allowed increase of nutritional value of yoghurt samples. There was obtained the increase of total proteins ($p>0.05$) and the decrease of fat ($p>0.05$). The presence of flakes from biologically activated hull-less barley grain and malt extract in yoghurt samples provided significant increase of amino acids amount ($p<0.05$) and riboflavin concentration ($p<0.05$).

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