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POSSIBILITY OF BETA-GLUCAN FROM SPENT BREWER'S YEAST ADDITION TO YOGHURTS

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The study was aimed at determining the possibility of beta-glucan from spent brewer's yeast addition to yoghurt. Analyses were conducted to determine the influence of beta-glucan addition on sensory characteristics and structure stability of yogurt. It has been stated that the sensorially perceived consistency attributes (thickness and smoothness) and flavour attributes (yoghurt, acid, bitter and "other") were significantly affected by beta-glucan content. The addition of beta-glucan influenced also the structure stability of yoghurts. Up to 0.3% addition of beta-glucan enabled maintaining the same sensory quality and structure stability of natural yoghurts as compared to the control sample (without beta-glucan). It is worth noting that a 250-g portion of yoghurt containing beta-glucan in the amount established in this work, could provide 0.7 g of beta-glucan.

INTRODUCTION

The interest in developing appropriate nutritional habits is thriving, driven mostly by the market potential for foods that can improve the health and well-being of consumers. On the other hand, a constantly growing knowledge of consumers stimulates the development of functional foods, containing ingredients that exert a beneficial effect on host health and/or reduce the risk of chronic diseases beyond basic nutritional functions [Charalampopoulos *et al*., 2002]. While searching for safe and natural, functional food ingredients it was found that beta-glucan could be a potential component of food [Brennan & Cleary, 2005]. The biological activity of those polysaccharides depends on many factors, amongs which the most important are considered to be their origin and method of their preparation [Thammakiti *et al*., 2004; Laroche & Michaud, 2007]. Functional and health-promoting properties of cereal beta-glucans, especially these of oats and barley, are the best recognized so far [Kalra & Jood, 2000; Lambo *et al*., 2005]. Much of the more recent interest in the use of beta-glucans obtained from spent brewer's yeast *Saccharomyces cerevisiae* has stemmed from their use as a new and more economic source of functional dietary fibre.

Research available in literature indicates high multidirectional biological activity of beta-glucans coming from yeast and this is related to improving the blood and liver lipid profiles as well as immunostimulating properties together with prebiotic and antioxidant effectiveness [Jung-Nam *et al*., 2001; Tsiapali *et al*., 2001; Waszkiewicz-Robak, 2006; Laroche & Michaud, 2007]. The products with beta-glucans may be considered as crucial in the prevention of many chronic diseases like as atherosclerosis, hypercholesterolemia or cancers and as valuable diet ingredient for people thinking of improving their immune system, especially for elderly or people exposed to permanent stress or high physical activity level [Waszkiewicz-Robak *et al.*, 2005].

Addition of beta-glucan to food increases their pro-health properties but at the same time causes changes in their sensory and physicochemical properties, that determine consumer willingness to buy food products [Lyly *et al*., 2007]. It is obvious that taste and other sensory characteristics of food occupy a key position in consumer's food choice [Urala & Lähteenmäki, 2004; Verbeke, 2006]. Therefore it is very important to keep similar sensory quality of food with added beta-glucans, as compared to those without fibers and to set up glucan level to be acceptable to consumers. Many recent studies have shown some possibilities of adding beta-glucans to food, yet most of them were dealing with beta-glucans from oats and barley [Temelli *et al*., 2004; Volikakis *et al*., 2004]. Therefore the objective of this study was to evaluate the effects of beta-glucan from spent brewer's yeast *Saccharomyces cerevisiae* on sensory and stability properties of natural yoghurts and to maintain beta-glucan content yielding sensory characteristics similar to those of a control sample without it.

MATERIAL AND METHODS

Material

The study sample included natural yoghurts of 3% fat content (declared by the producer) obtained with the container method. Yoghurts for examinations were provided by a recognized Polish producer. The research was performed during their shelf life period.

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Commercial insoluble beta-glucans obtained from spent brewer's yeast *Saccharomyces cerevisiae*, HP (Biolex®- Beta HP (1/3)-(1/6)-β-D-Glucane Powder), supplied by the German company LEIBER GmbH – INTER YEAST were used in the study. The amount of beta-glucans added to yoghurts ranged from 0.15% to 0.9%.

Sensory evaluation

Sensory evaluations were carried out by a specially trained sensory panel. The panel consisted of 9 members, who were extensively tested before being selected, according to ISO standard [PN-ISO 8586-2:1996]. They had much experience (theoretical and practical) with sensory procedures.

According to ISO standard [ISO-13299:2003], a Quantitative Descriptive Analysis (QDA) of yoghurts with added beta-glucan was performed to evaluate sensory characteristics of the samples. Members of the assessment panel were preliminarily familiarised with the samples and assessed individual attributes of odour, consistency and flavour. These attributes were discussed to reach uniform understanding by all panellists and their definitions were prepared. The intensity of attributes was measured using a 10-cm linear unstructured scale, anchored from 0 (attribute not perceived) to 10 (very intense).

A total of 6 products were evaluated in two independent replications. Samples (20 g) were placed in plastic beakers, covered with a watch glass and coded with random numbers. They were presented to the panellists in random order to avoid the so–called "carry-over effect", *i.e.* potential influence of a previous sample on the assessment of the next one.

All assessments were conducted in the Laboratory of Sensory Analysis of accredited Laboratory of Food Evaluation and Health Diagnostics. The Laboratory fulfils the requirements for sensory laboratories [PN-ISO 8589:1998].

Structure stability

Structure stability of yoghurts was determined with the method of optical measurement of backscattered or transmitted light intensity, using the optical scanning analyser Turbiscan (Turbiscan Lab., Formulation). Intensity of backscattered light (λ=880 nm) as a function of a sample tube length (mm) was measured.

Statistical analysis

Analysis of variance (ANOVA, $p \leq 0.05$) was applied to determine the significance of differences in the attribute's intensity among the samples. Principal Component Analysis (PCA) was conducted in order to study sensory attributes of yoghurts and to determine which were interrelated; also it helped in explaining variations among the samples.

RESULTS AND DISCUSSION

Figure 1 presents the selected characteristics of the sensory quality of natural yoghurts with added beta-glucan from spent brewer's yeast in the amount ranging from 0.15% to 0.9%. Beta-glucan additive did not influence considerably any of odour attributes of the yoghurts. Significant differences were observed, in turn, in attributes connected with consistency and flavour. With the increase of beta-glucan addition, the perception of sandiness and thickness was increasing – the samples containing 0.75 and 0.9% of beta-glucan were statistically less smooth and showed greater thickness in relation to the control yoghurt (without beta-glucan). Beta-glucan additive at 0.75 and 0.9% levels caused a statistically considerable decrease in yoghurt and acid flavour intensity with considerable growth of "other" and bitter flavour intensity. It was reflected in the overall quality assessment – the samples containing beta-glucan at 0.75% and 0.9% levels were characterised by a statistically considerably lower overall quality in respect of the control group and yoghurts with lower beta-glucan additive. Also, a change of colour was observed in these samples of yoghurt.

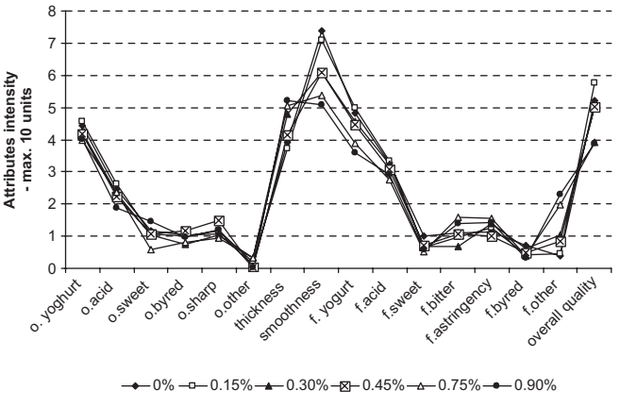

FIGURE 1. Characteristics of selected properties of the sensory quality of natural yoghurts with added beta-glucan from spent brewer's yeast, o. – odour attributes, f. – flavour attributes (% values express the amount of beta-glucan additive).

The PCA analysis (Figure 2) showed that the main sensory qualities causing sample variation were yoghurt flavour, "other" flavour, thickness and smoothness. These changes

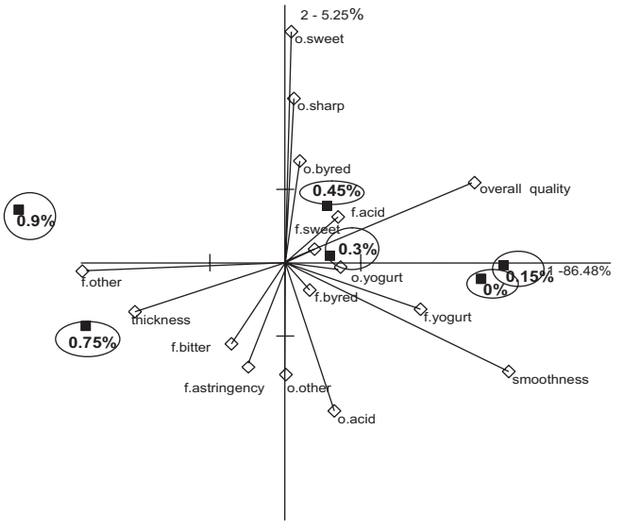

FIGURE 2. Principal Component Analysis plot of the sensory quality of natural yoghurts enriched with beta-glucan from spent brewer's yeast, f. – flavour attributes, o. – odour attributes (% values express the amount of beta-glucan additive).

were matched to the first principal component (86.48% of overall changeability) and mostly connected with beta-glucan amount. The control sample and the sample with the lowest beta-glucan additive (0.15%) were characterised by a very similar sensory quality with distinctly marked yoghurt note. Samples with 0.3 and 0.45% beta-glucan additive were found near the centre of the projection, in the proximity of acid flavour positively correlated with the overall quality. Different sensory characteristics were found in the samples with higher beta-glucan level (0.75, 0.9%), which were located on the opposite side of the projection, near attributes negatively correlated with the overall quality ("other" flavour, bitter flavour and thickness).

During the storage of yoghurts with added beta-glucan, in the amount established earlier as sensorically accepted, it was observed that in yoghurts containing 0.45% of beta-glucan "other" flavour intensity increased, smoothness decreased, which led to a diminished overall quality of these yoghurts samples. The samples of yoghurts containing beta-glucan at a level of 0.3% during the whole storage were characterised by the sensory quality similar to that of the control sample.

Based on the results obtained, the addition of beta-glucan from spent brewer's yeast was reported to significantly affect the sensory properties of yoghurts. Due to special molecular structure of added beta-glucan, the consistency of such attributes as thickness and smoothness was negatively changed. The prevalence of structural long side chains with β-(1→6) bonds makes beta-glucan hardly soluble in water. Other results revealed that native beta-glucan molecule from spent brewer's yeast were absorbing water and became five times larger during their hydration [Waszkiewicz-Robak, 2006]. The swollen molecules of beta-glucan trigger some undesirable changes, such as sandiness and the increased thickness in yoghurts. Addition of beta-glucan influenced yoghurt structure stability during storage (Figure 3). The backscattering profiles of the yoghurt sample without beta-glucan show an increase of the backscattering in the top part of the sample (right part of the graph). This is due to an increase in fat globules concentration in this part, which is characteristic for creaming phenomenon. The addition of beta-glucan prevented creaming. As the particles of beta-glucan swell they absorb water and increase density of the continuous phase of yoghurt, which prevents accumulation of fat globules on the yoghurt's surface. But at the same time, in consequence of beta-glucan particles swelling, a tendency of yoghurt for sedimentation increases – we observe a decrease of the backscattering in the top part of the sample (right part of the graph). As we add a small quantity of beta-glucan swelling particles are suspended in the yoghurt structure, thus we do not observe sediment layer formation – a lack of the backscatterig increase at the bottom part of the sample (left part of the graph).

An available literature confirmed the significant influence of beta-glucans on the sensory quality of fortified products. Volikakis *et al*. [2004] examining the effect of beta-glucans from oats on sensory properties of low-fat white-brined cheese, reported colour and overall quality to decrease at 0.7% of added beta-glucan. There were observed some off-tastes perceived as cereal, bean and flour-like. In other studies, there

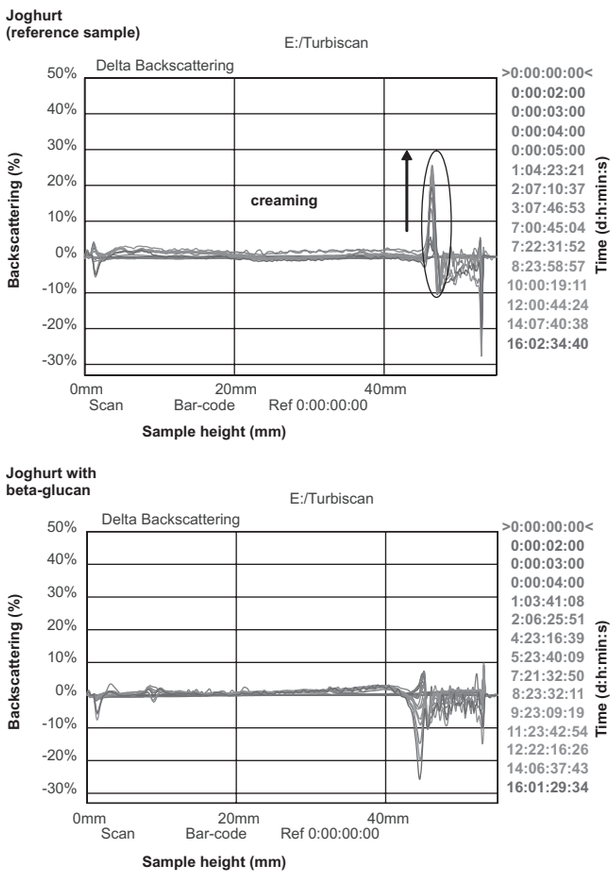

FIGURE 3. Influence of spent brewer's yeast beta-glucan addition on yoghurt stability – backscattering profiles of yoghurts (reference mode).

was found a significant influence of barley beta-glucan on the sensory quality of drinks [Temelli *et al*., 2004]. The main reason determining the use of this beta–glucan was their excessive viscosity due to high molecular weight of this beta-glucan form. The addition of barley beta-glucan at a level of 0.3% was acceptable, whereas its higher dose (0.5% and 0.7%) elicited undesirable changes in colour and viscosity of the drinks.

Some functional properties of beta-glucan preparations (*e.g.* sensory attributes, solubility, viscosity) significantly limited their addition level to enriched products. But it is worth noticing that beta-glucans, even in small quantities, demonstrate multi-directional biological activity. Studies on animals proved that a 2-mg daily portion of beta-glucan from spent brewer's yeast showed hipocholesterolemic and prebiotic properties [Waszkiewicz-Robak 2006]. Beta-glucan from spent brewer's yeast is a relatively new bioactive ingredient, so there is no recommendation concerning its intake level. Micronised beta-glucan from brewer's yeast, with a very high biological activity, is nowadays produced in the USA. Daily portion protecting from infections was stipulated at a level of 2.5-7.5 mg [Świderski & Waszkiewicz-Robak, 2002]. According to studies conducted in Norway, elderly people should consume daily 750 mg of beta-glucan from yeast *Saccharomyces cerevisiae* [Roberts *et al*., 2001].

On the basis of the conducted studies we can state that there is a possibility of adding beta-glucan from spent brewers yeast to yoghurt, at a level significant from the nutritional point of view. The yoghurt with sensorically-accepted level of beta-glucan from spent brewer's yeast provides 0.7 g of beta-glucan in a 250-g portion. Therefore this product might be considered as having health-promoting properties.

CONCLUSIONS

1. The addition of native beta-glucan from spent brewer's yeast to yoghurts was found to determine their sensory quality.

2. An addition of beta-glucan from spent brewer's yeast to yoghurts at a level of 0.3 g/100 g seems to be acceptable and does not change significantly their sensory quality and structure stability during storage.

3. The yoghurt containing 0.3% beta-glucan from spent brewer's yeast provides 0.7 g of beta-glucan in a 250-g portion. Therefore this product might be considered as having health-promoting properties.

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