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# THE EFFECT OF ADDITION OF SELECTED VEGETABLES ON THE MICROBIOLOGICAL, TEXTURAL AND FLAVOUR PROFILE PROPERTIES OF YOGHURTS

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**ABSTRACT**

**Background.** Vegetables, apart from having high nutritional value, also contain considerable amounts of dietary fibre and other components, which may affect physico-chemical properties of fermented milks, e.g. viscosity, texture, susceptibility to syneresis, flavour profile etc. The present work was established to study the effect of selected vegetables addition on the rheological, textural, microbiological and flavour profile parameters of yoghurts.
**Material and methods.** The vegetable preparations (carrot, pumpkin, broccoli and red sweet pepper) were added (10% w/w) to the processed cow's milk fermented with DVS yoghurt culture. Texture profile analysis, determination of viscosity, susceptibility to syneresis and descriptive flavour evaluation were conducted at the 1st, 7th and 14th day after production. Additionally, microbiological studies were performed for 28 days, at 7-day intervals.
**Results.** The highest apparent viscosity and adhesiveness were obtained for the carrot yoghurt, whereas yoghurt with pumpkin was the least susceptible to syneresis. The other texture parameters were not affected by the addition of vegetables. Broccoli and red sweet pepper flavours were dominating in the fermented milks fortified with these vegetables, whereas carrot and pumpkin flavours were less distinctive. Yoghurt supplemented with red sweet pepper got the highest sensoric acceptability. The number of starter bacteria was not influenced by the vegetable additives, except for pumpkin yoghurt, which contained lower population of lactobacilli.
**Conclusions.** Among all tested vegetables, carrot additive had the greatest potential to improve yoghurt structure, whereas red sweet pepper imparted the most acceptable flavour.

**Key words:** yoghurt, vegetables, texture, lactic acid bacteria, flavour profile

## INTRODUCTION

Yoghurt is the most popular fermented milk product that originates from countries around the Balkans and Eastern Mediterranean Sea (Jaros and Rohm, 2003). It is produced by milk fermentation with a mixture of two thermophilic starter bacteria i.e. *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus*. The quality and sensory acceptance of this product is in high degree determined by its physical properties like perceived viscosity and lack of visible wheying-off (Lee and Lucey, 2010). In relation to the

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rheological properties, yoghurt is a viscoelastic, pseudoplastic fluid which exhibits highly time-dependent shear thinning in flow. This behaviour is affected by many factors like: composition and pre-treatment of the milk (heat treatment, homogenisation), type of starter culture, presence of stabilisers, incubation conditions, and post-fermentation processes e.g. shearing in the case of stirred type yoghurt (Beal et al., 1999; Gün and Işıklı, 2007).

The aim of the present study was to assess textural and rheological properties, susceptibility to syneresis, flavour profile and acceptance of yoghurts with added carrot, pumpkin, broccoli and red sweet pepper preparations.

## MATERIAL AND METHODS

### Materials

Yoghurts were produced from fresh cows' milk obtained from a local milk farm (Olszanica, Poland). Instant non-fat milk powder (NMP) purchased from Dairy Company in Gostyn (Poland) was used for milk standardisation. Commercial YC-180 DVS yoghurt culture was obtained from Chr. Hansen (Denmark). The fresh (pumpkin, broccoli, red pepper) or frozen vegetables (carrot, Hortex, Skierniewice, Poland) were purchased from the local market during the autumn period.

### Preparation of vegetable pomaces

Fresh vegetables, i.e.: broccoli, pumpkin and red sweet pepper were washed, pumpkin and pepper were peeled (pepper after preheating in the oven at 200°C) and cut. All vegetables were cooked separately for 15–20 min in a small amount of water which was removed and then the vegetables were mixed to obtain homogenic preparations. The vegetable pomaces were transferred into the 200 ml glass jars, pasteurised in a water bath (85–90°C, 15 min), cooled in an ice-water bath for 20 minutes and stored at 4°C prior to use.

### Manufacture of yoghurts

Preparation of raw milk for yoghurt production involved the following steps: centrifugation (2% fat; milk separator mod. LWG24E, efficiency 100 L/h – Spomasz, Poland), standardisation to 5% protein content with NMP, homogenisation (60°C, 6 MPa) with a laboratory-scale FT 9 pressure homogeniser (Armfield, England), batch pasteurisation (85°C, 15 min) using a 20/27 L Kochstar A 2500 commercial pasteuriser with a heating mantle (Merten & Storck, Germany) and cooling to 44°C in an ice-water bath. Subsequently, milk was inoculated with the yoghurt culture in a dose of 0.0326 g/L, mixed and poured into 200 mL sterile glass jars. The fermentation proceeded at 43°C for ~6.5 h to achieve the 4.7 pH. After that, the fermented milks were cooled to 15°C and mixed (natural yoghurt) or mixed with 10% (w/w) of the respective vegetable pomace, i.e.: carrot, pumpkin, broccoli and red sweet pepper using sterile spatula. The yoghurts were stored at 4°C prior to analyses.

### Analyses

Susceptibility to syneresis was measured using the centrifugal method (Pluta et al., 1999).

The texture profile analysis (TPA) was performed using a texture analyser TA-XT2 (Stable Micro Systems, UK). The penetrometric test was done using a cylinder ($f$ = 20 mm) with a penetration depth of 25 mm at 1 mm/s penetration rate. The obtained diagrams (force vs. time) were analysed using the Texture Expert for Windows v. 1.05 software. The following parameters were calculated: hardness, adhesiveness, cohesiveness and gumminess.

Viscosity of the yoghurts was determined using the rotary viscometer Rheotest RV2 (VEB MLW Medingen, Germany) with controlled shear rate in a coaxial cylinder system S/S2 (internal to external radius of cylinder = 0.94). Apparent viscosity was calculated at the shear rate of 9 $s^{-1}$ during the increasing shear rate mode.

Descriptive flavour analysis (DFA) was performed by a panel of 5 trained judges using evaluation cards. The following parameters were assessed in a 0–5-point scale of the perceived intensity: yoghurt (acetaldehyde) odour, sour odour, carrot/pumpkin/broccoli/sweet pepper odour (respectively for each yoghurt type, this parameter was not evaluated for the plain natural yoghurt), unspecific odour, pleasant (desired) odour, sour taste, bitter taste, insipid taste, harsh taste, carrot/pumpkin/broccoli/sweet pepper taste (respectively for each yoghurt type, this parameter was not evaluated for the plain natural yoghurt), pleasant (desired) taste. The judges were also asked to give the notes for general acceptance.

The numbers of yoghurt bacteria, i.e.: *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* were determined by the plate technique at 37°C (ISO 7889:2003). Respectively, MRS and M17 agar (Biocorp, Poland) were used as media. Anaerobic conditions (20% $CO_2$) for the growth of lactobacilli were ensured by the use of $CO_2$ incubator.

All experiments were performed three times and analyses were done in duplicates. Sensory, textural and rheological studies were performed at the 1st, 7th and 14th day after production, whereas microbiological analyses were continued and determined also at the 21st and 28th day. In order to estimate the effect of vegetable addition and storage time, the obtained results were subjected to a two-way analysis of variance, and the significance of differences between the means was determined on the basis of the Duncan test at the significance level of $P \leq 0.05$ using Statistica 8.0 software (StatSoft, USA)

## RESULTS AND DISCUSSION

Results of susceptibility to syneresis, viscosity, textural (TPA) studies are shown in Table 1. The centrifugal method used for the determination of syneresis is a measure of the water-holding capacity under the action of high external force (Lee and Lucey, 2010). Cais-Sokolińska et al. (2004) observed a significant increase in the yoghurt susceptibility to syneresis with the duration of storage associated with the aging process of the curd. It is consistent with the results of our study as all products at the end of the experiment exhibited higher sensitivity to syneresis than yoghurts examined 1 day after production. These changes at the greatest extent were observed for the yoghurts with pumpkin (6.7% increase) and red sweet pepper (3.5% increase), whereas only a 1% increase was observed for the plain yoghurt. Hess et al. (1997) reported that susceptibility to syneresis, among other factors, is affected by the level of non-fat solids (SNF). Yoghurts manufactured in our study contained SNF respectively: natural – 12.72, carrot – 12.54, pumpkin – 12.48, broccoli – 12.04, red sweet pepper – 12.31% (Najgebauer-Lejko et al., 2014). However, the degree of syneresis observed for the natural yoghurt was significantly lower only in relation to the yoghurt with broccoli and red sweet pepper. Moreover, yoghurt with pumpkin preparation had a better characteristic concerning sensitivity to syneresis than other cultured milks. As wheying-off negatively affects consumer perception of yoghurts, manufacturers generally use two ways to prevent it, i.e. increment of total milk solids, especially protein, and addition of stabilisers, such as, pectin, gellatin and starch (McCann et al., 2011). Vegetables used as yoghurt additives in our study constitute a natural source of dietary fibre which may enhance water-holding capacity of the final products. McCann et al. (2011) observed enhanced viscoelastic properties and reduced whey loss of low-fat yoghurt fortified with dietary fibre-rich plant cell wall particles derived from carrot pomace.

The apparent viscosity measured for yoghurts highly depended on the time of storage. The highest values were stated after 1-week storage followed by further decline, except for yoghurt enriched with carrot preparation which was characterized by the highest viscosity at the 14th day of the study. Abu-Jdayil and Mohameed (2002) proposed that the rearrangement of the protein network is responsible for the increase in the apparent viscosity of the yoghurt during storage. The type of yoghurt also had a significant influence on that parameter. After 1 and 14 days the yoghurt enriched with carrot was the most viscous, whereas the highest viscosity at the 7th day was noticed for the plain yoghurt. Oroian et al. (2011) reported that, due to the presence of stabilisers, viscosity of commercial fruit yoghurts did not vary from that observed in plain products. In our study none stabilisers were used but fibre, which naturally occurs in the selected vegetables, can play the same role. According to USDA data (18), carrot (frozen, cooked, boiled, drained, without salt), broccoli, sweet red pepper and pumpkin (cooked, boiled, drained, without salt) contain respectively: 3.3, 3.3, 1.2, 1.1 g/100 g of dietary fibre. This may be the reason of the highest viscosity stated for the carrot yoghurt.

Texture profile analysis (TPA) imitates the conditions in the mouth by twice compressing a product (Yang and Li, 2010). The TPA test comprised the evaluation of such properties as: hardness, adhesiveness, cohesiveness and gumminess. Hardness is defined as the force needed to attain a given deformation. Adhesiveness is the work needed to overcome attractive force between food and other surface, whereas

**Table 1.** Results of syneresis, viscosity, TPA (texture profile analysis) and general acceptance in DFA (descriptive flavour analysis) evaluations of natural and vegetable yoghurts during storage (means ±SE, *n* = 6)

| Parameter | Storage time days | Yoghurt type | | | | |
|---|---|---|---|---|---|---|
| | | NY | CY | PY | BY | RPY |
| Syneresis, % v/v | 1[a] | 19.50 ±0.28 | 20.67 ±0.88 | 12.67 ±1.45 | 23.67 ±2.33 | 26.00 ±1.15 |
| | 7[a] | 24.00 ±2.31 | 19.00 ±2.64 | 23.33 ±2.73 | 28.33 ±2.33 | 26.00 ±1.73 |
| | 14[b] | 20.50 ±2.60 | 23.17 ±3.42 | 19.33 ±0.33 | 25.00 ±3.79 | 29.50 ±0.87 |
| | 1–14 | 21.33 ±1.21[a] | 20.94 ±1.40[a] | 18.44 ±1.80[a] | 25.67 ±1.61[b] | 27.17 ±0.87[b] |
| Apparent viscosity, Pa×s | 1[a] | 4.72 ±0.14 | 5.96 ±0.29 | 4.88 ±0.14 | 4.47 ±0.38 | 5.22 ±0.14 |
| | 7[b] | 8.44 ±0.09 | 7.70 ±0.53 | 6.30 ±0.09 | 7.37 ±0.53 | 6.62 ±0.57 |
| | 14[c] | 6.33 ±0.17 | 8.90 ±0.07 | 6.00 ±0.31 | 6.79 ±0.19 | 4.26 ±0.22 |
| | 1–14 | 6.50 ±0.54[a] | 7.52 ±0.46[b] | 5.73 ±0.24[cd] | 6.21 ±0.48[ac] | 5.37 ±0.39[d] |
| Hardness, N | 1[a] | 0.30 ±0.01 | 0.31 ±0.04 | 0.27 ±0.02 | 0.28 ±0.05 | 0.29 ±0.02 |
| | 7[b] | 0.36 ±0.02 | 0.36 ±0.02 | 0.34 ±0.02 | 0.37 ±0.02 | 0.31 ±0.02 |
| | 14[b] | 0.34 ±0.00 | 0.41 ±0.03 | 0.33 ±0.02 | 0.37 ±0.01 | 0.36 ±0.02 |
| | 1–14 | 0.33 ±0.01[a] | 0.36 ±0.02[a] | 0.31 ±0.01[a] | 0.34 ±0.02[a] | 0.32 ±0.02[a] |
| Adhesiveness, │N×mm│ | 1[a] | 1.94 ±0.01 | 2.32 ±0.04 | 1.67 ±0.02 | 2.46 ±0.23 | 1.67 ±0.31 |
| | 7[a] | 2.60 ±0.75 | 2.85 ±0.39 | 1.62 ±0.26 | 2.40 ±0.48 | 1.52 ±0.05 |
| | 14[a] | 1.93 ±0.12 | 2.82 ±0.66 | 1.82 ±0.56 | 1.81 ±0.56 | 2.26 ±0.51 |
| | 1–14 | 2.16 ±0.25[ab] | 2.66 ±0.24[a] | 1.71 ±0.18[b] | 2.22 ±0.19[ab] | 1.81 ±0.21[b] |
| Cohesiveness | 1[a] | 0.70 ±0.00 | 0.71 ±0.01 | 0.72 ±0.00 | 0.73 ±0.04 | 0.75 ±0.04 |
| | 7[a] | 0.85 ±0.11 | 0.68 ±0.02 | 0.73 ±0.00 | 0.67 ±0.02 | 0.70 ±0.02 |
| | 14[a] | 0.73 ±0.01 | 0.70 ±0.02 | 0.71 ±0.02 | 0.70 ±0.04 | 0.67 ±0.02 |
| | 1–14 | 0.76 ±0.04[a] | 0.70 ±0.01[a] | 0.72 ±0.01[a] | 0.70 ±0.02[a] | 0.71 ±0.01[a] |
| Gumminess, N | 1[a] | 0.22 ±0.01 | 0.22 ±0.03 | 0.19 ±0.02 | 0.20 ±0.03 | 0.21 ±0.00 |
| | 7[b] | 0.30 ±0.03 | 0.25 ±0.01 | 0.25 ±0.02 | 0.25 ±0.01 | 0.21 ±0.02 |
| | 14[b] | 0.25 ±0.00 | 0.28 ±0.02 | 0.24 ±0.01 | 0.26 ±0.00 | 0.24 ±0.01 |
| | 1–14 | 0.25 ±0.02[a] | 0.25 ±0.01[a] | 0.23 ±0.01[a] | 0.24 ±0.01[a] | 0.22 ±0.01[a] |
| General acceptance in DFA, scores | 1[a] | 4.42 ±0.17 | 3.88 ±0.12 | 3.90 ±0.10 | 4.13 ±0.12 | 4.40 ±0.60 |
| | 7[a] | 4.30 ±0.10 | 3.80 ±0.00 | 4.10 ±0.10 | 4.30 ±0.30 | 4.70 ±0.10 |
| | 14[a] | 4.54 ±0.21 | 4.00 ±0.00 | 3.84 ±0.16 | 3.42 ±0.08 | 4.75 ±0.25 |
| | 1–14 | 4.42 ±0.09[a] | 3.89 ±0.05[b] | 3.95 ±0.08[b] | 3.95 ±0.19[b] | 4.62 ±0.18[a] |

NY – natural yoghurt, CY – yoghurt with carrot, PY – yoghurt with pumpkin, BY – yoghurt with broccoli, RPY – yoghurt with red sweet pepper.
Mean values within each row or column followed by different letters in the superscript are significantly different at $P \leq 0.05$. Statistical data are obtained from the two-way ANOVA and present the effect of time (for all yoghurt types; columns) or yoghurt type (during the whole experiment; rows) on the given parameters.

cohesiveness represents strength of food's internal bonds. Gumminess, calculated as multiplication of hardness and cohesiveness, is defined as the force needed to disintegrate a semisolid food to a state ready for swallowing (Tunick, 2000; Yang and Li, 2010).

The level of hardness measured for yoghurts during the whole study fluctuated in the range of 0.27–0.41 N. The differences between the types of fermented milks when it comes to this feature were insignificant. On the contrary, hardness was affected by the storage time as higher values were observed for stored yoghurts. The structure of the protein network in yoghurt, which depends on the protein content, heat treatment of the bulk milk, fat content, thickening agents and bacterial exopolisaccharides, is responsible for hardness and cohesiveness, whereas ropiness contributes to adhesiveness (Hess et al., 1997). Among all products, carrot yoghurt was characterised by the highest adhesiveness, however the only significant difference was stated in relation to the pumpkin and red sweet pepper yoghurts. On the contrary, cohesiveness and gumminess did not vary for the different yoghurt types. In the case of both adhesiveness and cohesiveness storage duration was an insignificant factor, whereas gumminess tended to increase during the study.

The results of the descriptive flavour analysis (DFA) of the obtained yoghurts are shown in Figure 1 and 2 (A–C) and the scores for general acceptance in Table 1. Descriptive sensory tests involve the evaluation of the intensity of selected sensory properties and the results are used to create the organoleptic profile of food. It is a useful tool for product optimization, quality control and developing new products (Murray et al., 2001). The distinctive flavour of yoghurt, which should be clear, refreshing and slightly acidic, is attributed to the presence of lactic acid and volatile organic aroma compounds, mainly acetaldehyde (Beshkova et al., 1998). Different additives like: sweeteners, flavourings, fruits, preserves etc. modify the flavour of yoghurt (Routray and Mishra, 2011). Flavour defects may occur in yoghurts due to prolonged fermentation (too acidic) or insufficient fermentation (bland), excessive proteolysis (bitterness), microbiological contamination (yeasty, fruity, musty, cheesy, bitter or soapy-rancid off-flavours), too low incubation temperature or imbalanced growth of starter bacteria (too

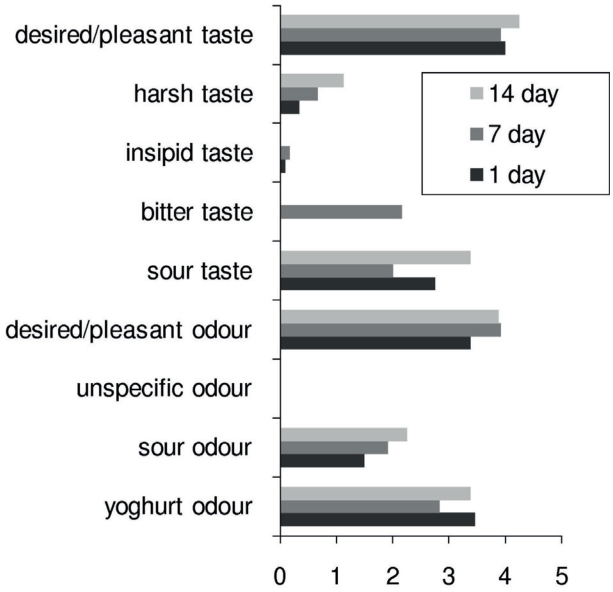


**Fig. 1.** Results of descriptive flavour analysis of the natural/plain yoghurt

little of characteristic flavour) or off-flavours in milk base (Walstra et al., 1999).

In our study the most pleasant/desired taste and odour was attributed to the yoghurt with red sweet pepper, which gained 4.29–4.75 (taste) and 3.55–4.75 (odour) score in a 0–5-point scale. Taking into account the whole investigated period, desirability of odour was estimated for the yoghurts in the following order: with red sweet pepper > natural > with broccoli > with pumpkin > with carrot. The same can be stated for taste, except for the taste of carrot which was more acceptable in yoghurts than the taste of pumpkin. Salwa et al. (2004) reported that yoghurt supplemented with 5–20% carrot juice was highly acceptable by the consumers due to its textural properties and pleasant taste. The higher odour scores for vegetable yoghurts were accompanied with the higher perception of the respective vegetable aroma. In the case of red sweet pepper and broccoli yoghurts the vegetable odour dominated over the yoghurt (acetaldehyde) one. In the examined fermented milks sour odour (0.4–2.37 points) and taste (1.54–3.5 points) were also detected. The intensity of these parameters increased throughout the storage period, especially for the broccoli yoghurt which tasted sour (3.5) and a little harsh (1.25) at the end

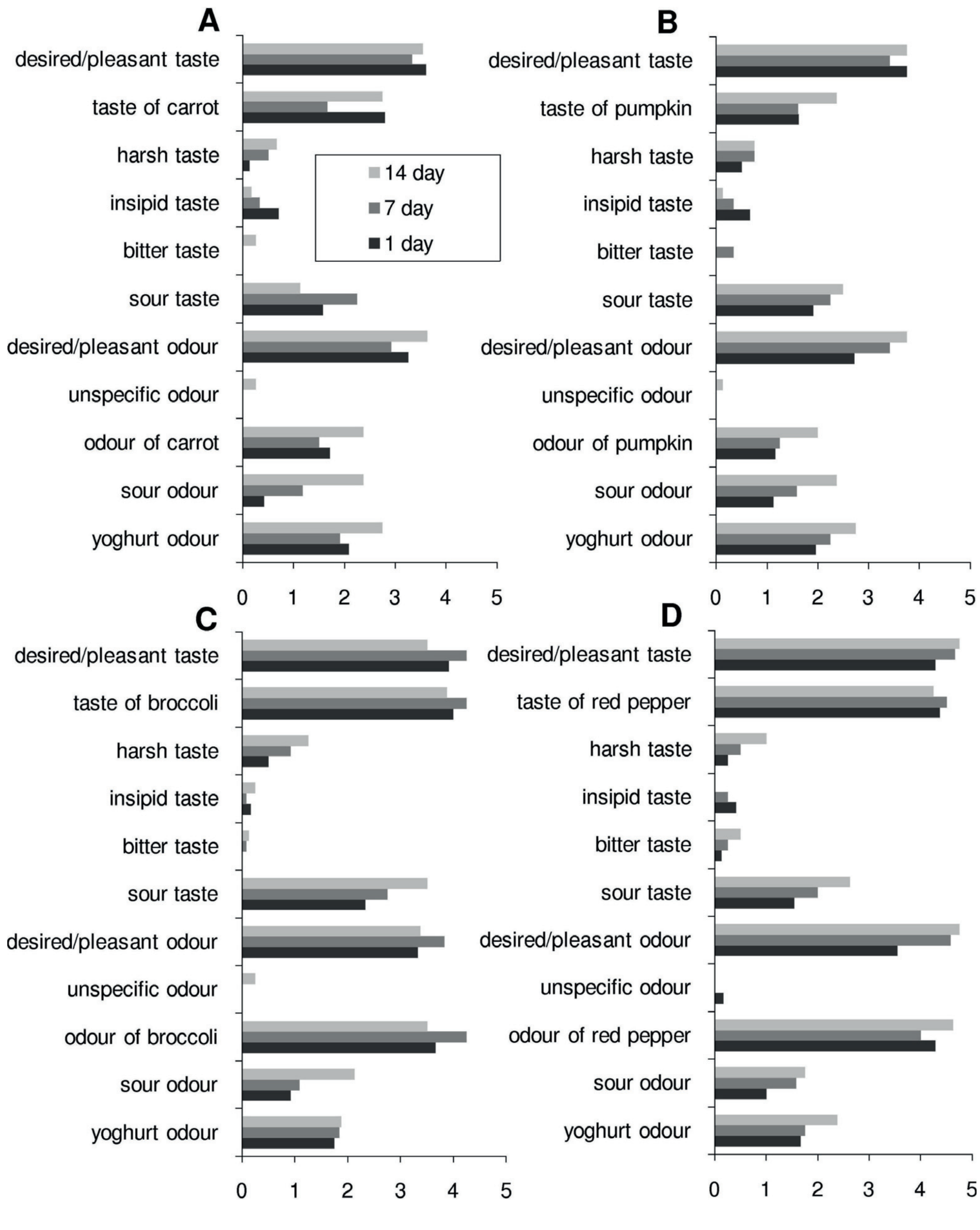


**Fig. 2.** Results of descriptive flavour analysis of the yoghurt with carrot (A), pumpkin (B), broccoli (C), red sweet pepper (D)

of the research which was reflected in the decreased acceptability of its taste and odour. Unspecific odour in the vegetable yoghurts was another factor occasionally perceived (usually at the end of the study) by the panellists but it was not very intense (maximum 0.25 points). Other tastes of a small importance perceived by the judges were: bitter and insipid taste. The latter was assessed as the most intensive in fresh carrot and pumpkin yoghurts (0.70 and 0.67 points, respectively). Generally, panellists, among all yoghurts, liked the one with the red sweet pepper the most – it received 4.40–4.75 notes for general acceptability.

**Table 2.** Starter bacteria count of natural and vegetable yoghurts during storage (means ±SE, *n* = 6).

| Parameter | Storage time days | Yoghurt type | | | | |
|---|---|---|---|---|---|---|
| | | NY | CY | PY | BY | RPY |
| *S. thermophilus* count, log cfu/mL | 1[a] | 9.11 ±0.09 | 9.33 ±0.22 | 9.56 ±0.20 | 10.08 ±0.52 | 9.41 ±0.13 |
| | 7[a] | 9.39 ±0.12 | 9.24 ±0.01 | 9.41 ±0.21 | 9.27 ±0.03 | 9.26 ±0.09 |
| | 14[a] | 9.37 ±0.21 | 9.28 ±0.05 | 9.31 ±0.12 | 9.60 ±0.13 | 9.24 ±0.12 |
| | 21[a] | 9.28 ±0.17 | 9.31 ±0.06 | 9.31 ±0.07 | 9.35 ±0.17 | 9.27 ±0.12 |
| | 28[a] | 9.24 ±0.16 | 9.06 ±0.10 | 9.44 ±0.15 | 8.98 ±0.06 | 9.03 ±0.11 |
| | 1–28 | 9.28 ±0.06[a] | 9.24 ±0.05[a] | 9.41 ±0.06[a] | 9.46 ±0.14[a] | 9.24 ±0.05[a] |
| *Lb. delbrueckii* ssp. *bulgaricus* count, log cfu/mL | 1[a] | 8.21 ±0.03 | 8.09 ±0.05 | 8.00 ±0.05 | 8.23 ±0.05 | 8.16 ±0.07 |
| | 7[a] | 8.21 ±0.10 | 8.06 ±0.05 | 7.79 ±0.14 | 8.27 ±0.01 | 8.20 ±0.03 |
| | 14[ab] | 8.00 ±0.21 | 8.12 ±0.16 | 7.98 ±0.03 | 8.12 ±0.02 | 7.94 ±0.17 |
| | 21[ab] | 8.17 ±0.18 | 8.10 ±0.03 | 7.90 ±0.10 | 7.89 ±0.05 | 8.16 ±0.06 |
| | 28[b] | 7.99 ±0.13 | 7.93 ±0.13 | 7.94 ±0.24 | 8.16 ±0.07 | 8.01 ±0.01 |
| | 1–28 | 8.12 ±0.06[a] | 8.06 ±0.04[ab] | 7.92 ±0.05[b] | 8.15±0.04[a] | 8.10 ±0.04[a] |

NY – natural yoghurt, CY – yoghurt with carrot, PY – yoghurt with pumpkin, BY – yoghurt with broccoli, RPY – yoghurt with red sweet pepper.
Mean values within each row or column followed by different letters in the superscript are significantly different at $P \leq 0.05$. Statistical data are obtained from the two-way ANOVA and present the effect of time (for all yoghurt types; columns) or yoghurt type (during the whole experiment; rows) on the given parameters.

The number of characteristic microorganisms was in most cases unaffected by the yoghurt type (Table 2). Only the product with added pumpkin pomace showed lower level of lactobacilli ($P \leq 0.05$) and slightly higher (but not significantly, $P > 0.05$) count of streptococci than other yoghurts. Regardless the fact, that there was observed a significant decrease in the number of *Lb. delbrueckii* ssp. *bulgaricus* at the end of the experiment, the level of both yoghurt bacteria met the required criteria of min. $10^7$ cfu/g (FAO/WHO, 2003) during the entire study.

## CONCLUSIONS

The yoghurts supplemented with selected vegetables exhibited good viscosity and textural properties as well as microbiological quality which usually did not differ significantly from that stated for the plain product. Carrot yoghurt was characterised by the highest apparent viscosity and adhesiveness which may result from the high content of dietary fibre in that vegetable. In yoghurts with carrot and pumpkin the yoghurt odour dominated over the aroma of the respective vegetable, whereas broccoli and sweet red pepper odours were less distinctive. The flavour of sweet red pepper in yoghurt was highly acceptable by the sensory assessors. The results of the present study suggest that the combination of milk yoghurt with selected vegetables has a great potential to create novel functional food products, not only with enhanced health-promoting properties as reported in our previous work (Najgebauer-Lejko et al., 2014), but also with unique sensory properties and good mechanical properties achieved without additional stabilisers. On the other hand, some efforts need to be put to develop products with desirable and optimal sensory attributes before their launch to the market.

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## WPŁYW DODATKU WYBRANYCH WARZYW NA JAKOŚĆ MIKROBIOLOGICZNĄ, TEKSTURĘ ORAZ PROFIL SMAKOWO-ZAPACHOWY JOGURTÓW

### STRESZCZENIE

**Wstęp.** Warzywa, poza dużą wartością odżywczą, zawierają znaczne ilości błonnika pokarmowego oraz inne składniki, które mogą wpływać na cechy fizykochemiczne mleka fermentowanego, takie jak lepkość, tekstura, podatność na synerezę czy profil sensoryczny. Celem pracy było określenie wpływu dodatku wybranych warzyw na właściwości reologiczne, mikrobiologiczne, teksturę oraz profil smakowo-zapachowy jogurtu.
**Materiał i metody.** Przeciery warzywne (z marchwi, dyni, brokuła oraz czerwonej papryki) dodano w ilości 10% (w/w) do krowiego mleka fermentowanego z użyciem kultury jogurtowej typu DVS. Analizę profilu tekstury, oznaczenie lepkości, podatności na synerezę oraz analizę profilu smakowo-zapachowego przeprowadzono w 1, 7 oraz 14 dniu po produkcji. Oznaczenie jakości mikrobiologicznej wykonano w trakcie 28 dni w tygodniowych odstępach.
**Wyniki.** Największe wartości lepkości dynamicznej oraz adhezyjności charakteryzowały jogurt marchwiowy, natomiast jogurt z dynią był najmniej podatny na synerezę. Dodatek warzyw nie miał istotnego wpływu na pozostałe parametry tekstury. Aromaty brokułu oraz papryki dominowały nad aromatem aldehydu octowego w jogurtach z dodatkiem tych warzyw, natomiast aromaty marchwi oraz dyni były słabiej wyczuwalne. Największą akceptowalnością sensoryczną charakteryzował się jogurt z czerwoną papryką. Liczba bakterii starterowych nie była zdeterminowana dodatkiem warzyw, z wyjątkiem jogurtu dyniowego, który zawierał mniejszą ilość pałeczek mlekowych.
**Wnioski.** Spośród wszystkich przebadanych dodatków warzywnych przecier marchwiowy najbardziej poprawił strukturę jogurtu, natomiast jogurt z czerwoną papryką charakteryzował się najkorzystniejszym profilem smakowo-zapachowym.

**Słowa kluczowe:** jogurt, warzywa, tekstura, bakterie kwasu mlekowego, profil smakowo-zapachowy

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