NUTRITIVE CHARACTERISTICS OF PROBIOTIC QUARG AS INFLUENCED BY TYPE OF STARTER

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Quarg was manufactured, under laboratory conditions, by standard batch process, from two types of milk: I) partially skimmed, with 1.6 % of fat and II) whole milk, with 3.5 % of fat. As starters, two probiotic cultures were applied: I) DVS-Probio-Tec™ ABT-1, Lactobacillus acidophilus-5, Bifidobacterium-12, S. thermophilus and II) DVS-Probio-Tec™ ABT-2, Lactobacillus acidophilus-5, Bifidobacterium-12, S. thermophilus. Also, the traditional cheese culture (CH - N22) was used. The obtained Quarg samples were tested by standard methods in order to determine their nutritive characteristics. The results have shown that probiotic starter ABT-1 ensured the highest level of utilization of fat, proteins, lactose and phosphorus from partially skimmed milk. Probiotic culture ABT-2 was less effective, but combined with the traditional starter and applied to a whole milk could give Quarg with acceptable nutritive characteristics. When sensory characteristics of products were tested, it has been proven that the application of ABT-2 culture and combination of probiotic starters ABT-2 and traditional culture gave good products with typical mild flavour. On the contrary, inoculation with ABT-1 probiotic starter resulted in lower-quality products in case of both kinds of milk applied.

KEY WORDS: probiotics, quarg, nutritive characteristics, sensory characteristics

INTRODUCTION

The importance of probiotic-containing products for maintaining human health results in a rapid growth of the market for such products. It has been proven that probiotic microorganisms (bacteria and/or yeasts) exhibit a beneficial effect on the health of the consumers when ingested (1-2). Very popular food delivery systems for these cultures are freshly fermented dairy products (3-5). Special place belongs to Quarg – an acid-precipitated cheese.
So, when the traditional starter cultures are replaced by adequate probiotic cultures, positive impact to consumers’ health can be expected.

However, such a replacement can not be done arbitrarily; the probiotic substitute must guarantee: successful fermentation of lactose, coagulation of milk, formation of solid gel, decrease of pH value, production of anti-microbial component, decrease of oxidative-reductive potential of the system, etc. (6-10).

This investigation compares both nutritive and sensory characteristics of probiotic products to traditional Quarg, with the aim to suggest replacement of the traditional culture if possible.

MATERIALS AND METHODS

As raw materials, two kinds of milk were used: milk with 1.6 % of fat and milk with 3.5 % of fat. Their composition is presented in Table 1.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>MILK-I</th>
<th>MILK-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter, %</td>
<td>10.09</td>
<td>12</td>
</tr>
<tr>
<td>Fat, %</td>
<td>1.6</td>
<td>3.5</td>
</tr>
<tr>
<td>Total proteins, %</td>
<td>3.00</td>
<td>3.44</td>
</tr>
<tr>
<td>Lactose, %</td>
<td>4.72</td>
<td>4.32</td>
</tr>
<tr>
<td>Ash, %</td>
<td>0.77</td>
<td>0.74</td>
</tr>
<tr>
<td>Lactic acid, %</td>
<td>0.153</td>
<td>0.146</td>
</tr>
<tr>
<td>pH, unit</td>
<td>6.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Acidity, °SH</td>
<td>6.8</td>
<td>6.6</td>
</tr>
<tr>
<td>Total nitrogen, %</td>
<td>0.47</td>
<td>0.54</td>
</tr>
<tr>
<td>Phosphorus, mg (100 g)⁻¹</td>
<td>87.9</td>
<td>84.1</td>
</tr>
</tbody>
</table>

Raw milk was exposed to a process consisting of steps presented in Fig. 1, resulting in Quarg (11,12). The starters, applied for inoculation of pasteurized milks, were as follows: I) DVS-Probio-Tec™ ABT-1 (Lactobacillus acidophilus-5, Bifidobacterium-12, S. thermophilus) as a probiotic culture, II) DVS-Probio-Tec™ ABT-2 (Lactobacillus acidophilus-5, Bifidobacterium-12, S. thermophilus, Chr. Hansen) as a probiotic culture, and III) FD CH-N22 (Lc. lactis subsp. Lactis, Lc. Lactis subsp. cremoris, Leuconostoc mesenteroides subsp. cremoris, Lactococcus lactis subsp. lactis biovar diacetylactis) as a traditional culture. Coagulation was performed by enzyme Hannilase L 2235 (microbiology protease, isolated from Rizomucor miehei, Chr. Hansen, A/S, Denmark).

In order to investigate the effect of type and quantity of starter upon nutritive and sensory characteristics of the obtained cheeses, the experiments were planned as presented in Fig. 2. Quarg samples were produced by applying traditional starter culture (CH-N22), probiotics starters (ABT-1, ABT-2), and combination of probiotics and traditional culture in ratios: 1:1 and 1:3.
Relevant characteristics of raw milk were determined as follows: I) dry matter (DM), measured by drying at 105°C, IDF ISO 21A (1982), II) fat (F), according to Gerber, IDF ISO 105/1981, III) total nitrogen (TN), according to Kjeldahl, IDF/ISO 20 (1962), IV) total proteins (TP), calculated by multiplying total nitrogen by 6.38 %, V) lactose (L), measured by titration, IDF/ISO method 28 (1964), VI) ash (ASH), measured by burning at temperature 550°C, IDF/ISO 90/1979 (11), VII) lactic-acid, based on Soxlet-Henkel measurements and data in the reference (13), VIII) pH, measured by pH-meter Iskra, MA 5713, Kranj, Slovenija (11), IX) acidity, according to Soxlet-Henkel (13), “SH and X) phosphorus (P), according to JUS ISO 13730 method (1999).
Relevant characteristics of Quarg were determined as follows: I) dry matter (DM), measured by drying at 105°C, IDF ISO 21A (1982), II) fat (F), according to Van Gulik (11), III) total nitrogen (TN), according to Kjeldahl, IDF/ISO 20 (1962), IV) total proteins (TP), calculated by multiplying total nitrogen by 6.38 %, V) lactose (L), calculated by formula: \( L = DM - (TP + F + ASH) \), VI) phosphorus (P), according to JUS ISO 13730 method (1999) and VII) energy value (EV), calculated by the formula: \( EV = 4.186 \times (9.3 \times F + 4.4 \times TP + 4.1 \times L) \), kJ (100 g)-1.

Sensory quality of Quarg samples was evaluated by experts judging: appearance (max 1 point), colour (max 2 points), consistency (max 4 points), odour (max 3 points) and taste (max 10 points).

RESULTS AND DISCUSSION

Nutritive characteristics of the manufactured cheese samples are presented in Figs. 3-7. Samples within each series differ among themselves in regard of the type and quantity of the applied starter (see Fig. 2).

Analysis of functions in Figs. 3a and 3b shows that the highest utilization of fat from both milks was achieved by probiotic starter ABT-1. Less effective fat utilization is typical of probiotic starter ABT-2, particularly when applied to the lower fat milk- I.

Fig. 3a. Fat content in series I as a function of type and quantity of starter

Fig. 3b. Fat content in series II as a function of type and quantity of starter
When total proteins are concerned (see Figs. 4a and 4b), probiotic starter ABT-1 has shown excellent activity if milk-I (with lower content of total proteins) was used. Accordingly, the product from milk-I, which was inoculated with ABT-1, has absolutely the highest content of total proteins.

Fig. 4a. Total proteins in series I as a function of type and quantity of starter

Utilization of lactose was very high when ABT-1 probiotic starter was applied to milk-I with higher lactose content (Fig. 5a). Also, probiotic ABT-2 has shown significant efficiency while applying to milk-I (Fig. 5a). Very high level of lactose utilization was achieved with the product from milk-II, inoculated with a combination 0.0075 CH-N22: 0.0025 ABT-2 (Fig. 5b).

Fig. 5a. Lactose content in series I as a function of type and quantity of starter
Content of phosphorus in milk-I was slightly greater than the content of phosphorus in milk-II. However, significantly greater P content was achieved in cheeses manufactured from milk-I after inoculation with probiotics ABT-1 and ABT-2 (Fig. 6a). A lower P-utilization characterizes the process on the whole milk-II, regardless of the starter applied (Fig. 6b).

When energy values of probiotic cheeses were estimated, much higher values were obtained in the case of whole-milk products, regardless of the starter culture applied. This is a consequence of a high level of fat in the whole milk, which significantly contributes to the energy value.

Sensory characteristics of products were determined as presented in Figs. 7 and 8.
Analysis of the results in Figs. 7 and 8 shows that the application of ABT-2 probiotic culture and traditional culture (and combined) gives good products with typical mild flavour. However, inoculation with ABT-1 probiotic starter results in products of lower quality for both milks (sample 2 in Fig. 7 and sample 9 in Fig. 8). When ABT-1 was combined with the traditional starter it proved quite acceptable.

**CONCLUSION**

Increasing demand for foods containing probiotics requires research and development of such products. Quarg cheese can undoubtedly be a delivery system for viable probiotic cultures if manufactured by applying probiotic starters, despite the fact that the thermal treatment was applied. By this investigation, it has been proven that probiotics DVS-Probio-Tec™ ABT-1 (\textit{Lactobacillus acidophilus}-5, \textit{Bifidobacterium}-12, \textit{S. thermophilus}) ensured the highest level of utilization of fat, proteins, lactose and phosphorus from parti-
ally skimmed milk. The other probiotic culture, DVS-Probio-Tec™ ABT-2 (*Lactobacillus acidophilus*-, 5, *Bifidobacterium*-12, *S. thermophilus*) was less effective, but combined with the traditional starter and applied to a whole milk could give Quarg with acceptable nutritive characteristics. When sensory characteristics of products were tested, it has been proven that the application of ABT-2 culture and traditional culture (and combined) gave good products with typical mild flavour. On the contrary, inoculation with ABT-1 probiotic starter resulted in products of lower quality in case of both milks applied.

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REFERENCES

НУТРИТИВНЕ КАРАКТЕРИСТИКЕ ПРОБИОТИЧКОГ КВАРКА У ЗАВИСНОСТИ ОД ТИПА СТАРТЕРА

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Произведен је кварк, у лабораторијским условима, у стандардном batch процесу, од два типа млека: I) делимично обранин, са 1.6% маси и II) пуномасног млека са 3.5% масе. Као стартери, примењено су две пробиотичке културе: I) DVS-Probio-Tec™ ABT-1, Lactobacillus acidophilus-5, Bifidobacterium-12, S. thermophilus и II) DVS-Probio-Tec™ ABT-2, Lactobacillus acidophilus-5, Bifidobacterium-12, S. thermophilus. Такође, коришћена је традиционална култура (FD CH-N22, Lc. lactis subsp. lactis, Lc. Lactis subsp. cremoris, Leuconostoc mesenteroides subsp. cremoris, Lactococcus lactis subsp. lactis biovar diacetylactis). Добијени узорци кварка тестирани су стандардним методама у циљу одређивања њихових нутритивних карактеристика. Резултати су показали да пробиотик ABT-1 обезбеђује висок ниво искоришћења масе, протеина, лактозе и фосфора из делимично обранин млека. Пробиотик ABT-2 је мање ефикасан, али комбинован са традиционалним стартером и примењен на пуномасно млеко може да да кварк прихватљивих нутритивних карактеристика. При тестирању сензорних карактеристика производа, било је доказано да примена ABT-2 културе и традиционалне културе (чистих или комбинованих) даје производ типичног, благог укуса. Насупрот томе, инокулација примењом пробиотичког стартера (ABT-1) као резултат даје мање квалитетне производе у случају примене обе врсте млека.

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