USE OF MILK-BASED KOMBUCHA INOCULUM FOR MILK FERMENTATION

Radomir V. Malbaša, Eva S. Lončar, Spasenija D. Milanović and Ljiljana A. Kolarov

In this investigation fermented milk beverages with 0.9% of milk fat were produced using 10 and 15% (v/v) of traditional and milk-based kombucha inoculum by application of appropriate technological process.

Milk fermentation using two types and concentrations of kombucha inoculum were stopped when the pH reached 4.5. Sigmoidal fermentation profiles were noticed with traditional kombucha inoculums and linear with milk-based kombucha inoculums.

Chemical content and physico-chemical characteristics of kombucha fermented milk beverages were typical and yoghurt-like for all obtained products.

The best textural and sensory characteristics possessed beverage obtained in fermentation of milk using 10% (v/v) of milk-based kombucha inoculum.

KEY WORDS: Kombucha, milk fermentation, milk-based kombucha inoculum, product quality

INTRODUCTION

Kombucha is well-known symbiotic association of several yeast species and acetic bacteria, whose metabolic activity on tea sweetened with sucrose produces a pleasant refreshing beverage, containing a number of useful compounds (1). In addition to sucrose, application of other sugars (glucose, fructose, lactose) is possible. This may have major effect on the formation of lactic acid as product (2).

As far as lactose fermentation by kombucha is concerned, only a few investigations have been reported; Lončar et al. (2001) reported findings of metabolic activity of kombucha on milk (3), whilst, Bellosa-Morales and Hernández-Sánchez (2003) described the production of beverage from cheese whey (4). Malbaša et al. (2009) investigated milk fermentation using kombucha inoculums with black, green tea and Jerusalem artichoke tubers extract (5). Investigations of Lončar et al. (2001) and Malbaša et al. (2009) shows significantly longer durations of kombucha fermentations on milk comparing to probiotic yoghurt fermentation (1, 5).

This paper describes the manufacture of fermented milk beverages with 0.9% of milk fat using 10 and 15% (v/v) of traditional kombucha inoculum and also milk-based kom-
bucha inoculum by application of appropriate technological process. It investigates quality of obtained products comparing chemical composition, physico-chemical, textural and sensory characteristics.

**EXPERIMENTAL**

**Milk**

Homogenized and pasteurized cow’s milk with 0.9% fat, 3.3% protein and 4.8% lactose, produced in Novosadska mlekara, Novi Sad, Serbia, was used for the fermentation.

**Kombucha culture**

Local kombucha culture containing *Acetobacter xylinum* and at least five yeast strains (*Saccharomycodes ludwigii*, *Saccharomyces cerevisiae*, *Saccharomyces bispores*, *Turolopsis* sp. and *Zygosaccharomyces* sp.) was applied for production of fermented milk beverages (6).

**Production of beverages**

Fermented milk-based kombucha beverages were produced from milk inoculated at 43°C. Two amounts of traditional kombucha inoculum (5) obtained on sweetened black tea of 10 and 15% (v/v) were used. The fermentations lasted up to reach pH 4.5. The obtained gels were cooled to 8°C, homogenized by mixing, and packed in plastic glasses. Two beverages marked T10% and T15% were obtained. Further, T10% and T15% were used as inoculums for the next fermentation on milk following the procedure described above. Inoculum amounts were 10% (v/v) of T10% and 15% (v/v) of T15%. Beverages marked MB10% and MB15% were obtained.

**Methods of analysis**

The chemical content of obtained products was analyzed using standard methods (7). Syneresis of whey was analyzed by method of Atamer et al. (8).

Water holding capacity (WHC) (%) represents the amount of whey drained after centrifugation of 20 g of sample during 30 minutes at room temperature.

Textural characteristics were investigated using Texture analyser TA.Xplus (Micro Stable System, England) at 4°C.

Sensory characteristics of obtained products were examined by qualified evaluators, who assessed each particular element of quality as follows: appearance, colour, consistency, odour and taste. Possible marks for each separate characteristic were in a range from 1 to 5.

**RESULTS AND DISCUSSION**

In Fig. 1 are presented fermentation curves for both inoculums and their concentrations.
Fermentations with traditional kombucha inoculum were stopped when pH reached 4.5. It needed about 12.5 hours for both inoculum concentrations. During first 6 to 7 hours were not noticed pH changes which caused sigmoidal fermentation curves.

Fermentations with milk-based kombucha inoculums were for about two times shorter. pH changes were almost linear. The reason for such behaviour was absence of period for adaptation to substrate which was necessary for microorganisms in traditional kombucha inoculum. The very important fact is reasonably shorter fermentation with milk-based kombucha inoculum primarily for the economic reasons.

Obtained results with milk-based inoculums are in accordance to investigations of Lončar et al. (2001) and Milanović et al. (2002), where is proved that higher inoculum concentration affects shorter fermentation time (3, 9).

Chemical content of obtained beverages is presented in table 1.

Table 1. Chemical content of fermented milk beverages

<table>
<thead>
<tr>
<th>Component (%)</th>
<th>Beverage</th>
<th>T10%</th>
<th>T15%</th>
<th>MB10%</th>
<th>MB15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td></td>
<td>9.52</td>
<td>9.55</td>
<td>10.09</td>
<td>11.01</td>
</tr>
<tr>
<td>Fat</td>
<td></td>
<td>0.86</td>
<td>0.86</td>
<td>0.89</td>
<td>0.88</td>
</tr>
<tr>
<td>Total proteins</td>
<td></td>
<td>3.13</td>
<td>3.06</td>
<td>3.61</td>
<td>3.44</td>
</tr>
<tr>
<td>Ash</td>
<td></td>
<td>0.72</td>
<td>0.66</td>
<td>0.84</td>
<td>0.82</td>
</tr>
<tr>
<td>Acidity (SH°)</td>
<td></td>
<td>28.6</td>
<td>31.6</td>
<td>27.6</td>
<td>31.2</td>
</tr>
</tbody>
</table>

Dry matter content is approximately the same in T10% and T15%, and in MB10% and MB15% is slightly higher. In MB15% is measured the highest dry matter content which
is logical because of applied inoculum that itself contains the higher amount of dry matter. The same explanation could be used for the ash and protein content which is higher in MB10% and MB15%.

Values of acidity expressed in SH° were higher in samples T15% and MB15% which means that inoculum concentration affects acidity of product.

Average chemical content of obtained fermented beverages is in a range of results obtained in earlier investigations of possibility of kombucha application in production of fermented milk beverages (5).

In table 2 are presented some physico-chemical characteristics of fermented milk beverage.

**Table 2.** Physico-chemical characteristics of fermented milk beverages

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Beverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T10%</td>
</tr>
<tr>
<td>Syneresis (mL)</td>
<td>35.0</td>
</tr>
<tr>
<td>Water holding capacity (WHC) (%)</td>
<td>34.5</td>
</tr>
</tbody>
</table>

Values of syneresis were in narrow interval as well as water holding capacity (WHC). Higher WHC indicates better quality of products but it was not possible to point any of produced beverages in a view of this parameter. Similar results obtained Duraković et al. (2008) who investigated fermentation of milk with 0.9% milk fat with concentrated kombucha inoculums (10).

Textural characteristics of obtained products are presented in table 3.

**Table 3.** Textural characteristics of fermented milk beverages

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Beverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T10%</td>
</tr>
<tr>
<td>Firmness (g)</td>
<td>15.616</td>
</tr>
<tr>
<td>Consistency (gs)</td>
<td>444.158</td>
</tr>
<tr>
<td>Cohesivity (g)</td>
<td>-5.340</td>
</tr>
<tr>
<td>Index of viscosity (gs)</td>
<td>-1.106</td>
</tr>
</tbody>
</table>

Results presented in table 3 show that the highest firmness had MB10% and in the other samples firmness was very similar. The same pattern was for the consistency. Consistency value indicates higher density of the product.

Higher negative value represents more cohesive sample. The maximum value of cohesiveness was noticed also for MB10%. The same manner was found for the viscosity index.

Values of textural parameters of quality of MB10% were significantly higher in comparison to the other produced fermented milk beverages and that characteristics recommend this sample for further investigation and production.

Sensory characteristics of fermented milk products are the most important for consumers. In table 4 are presented the results of sensory analysis.

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Table 4. Sensory characteristics of fermented milk beverages

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Beverage</th>
<th>T10%</th>
<th>T15%</th>
<th>MB10%</th>
<th>MB15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Colour</td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Consistency</td>
<td></td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Odour</td>
<td></td>
<td>4.5</td>
<td>4.5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Taste</td>
<td></td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Scores of sensory analysis indicate that usage of milk-based kombucha inoculum affect better characteristics of fermented milk beverage (Table 4), and taste of MB10% and MB15% was characterized as mild and refreshing, but at all it was better composed in MB10%. Appearance, colour and consistency of products were characteristic for the yoghurt-like products. Odour also was more intensive and typical in products obtained using milk-based kombucha inoculums for fermentation.

The best sensory total mark is for MB10% which has the best textural characteristics too (Table 3).

CONCLUSION

Milk-based kombucha inoculum is better than traditional one because of economic reasons. It shortened milk fermentation for almost two times.

Chemical content and physico-chemical characteristics of kombucha fermented milk beverages were typical for all obtained products.

The best textural and sensory characteristics had beverage obtained in fermentation of milk using 10% (v/v) of milk-based kombucha inoculum which is potentially very interesting for further investigations.

ACKNOWLEDGEMENT

Financial support from the Ministry of Science and Technological Development of Serbia is highly acknowledged (Grant TR-20008).

REFERENCES


ПРИМЕНА МЛЕЧНО-ФЕРМЕНТИСАНОГ ИНОКУЛУМА КОМБУХЕ ЗА ФЕРМЕНТАЦИЈУ МЛЕКА

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У овом истраживању су произведені ферментисани млечни производи од млека са 0,9% млечне масти користећи 10 и 15% (v/v) традиционалног и млечно ферментисаног инокулума комбухе применом одговарајућег технологског процеса.

У свим ферментацијама је процес заустављен када је вредност pH достигла 4,5. Уочене су сартимидалне ферментационе криве где је коришћен традиционални инокулум комбухе и линеарне за млечно ферментисани инокулум комбухе.

Хемијски састав и физичко-хемијске карактеристике комбуха ферментисаних млечен производа су били типични и слични јогурту код свих производа.

Најбоље текстуралне и сензорне карактеристике је имао напитак произведен ферментацијом млека са 10% (v/v) млечно ферментисаног инокулума.

Received 9 July 2009
Accepted 9 September 2009