Influence of starter and sweetener on the syneresis intensity of fermented milk drink

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ABSTRACT:

Syneresis represents the appearance of separation of whey on the surface of the product and is considered an important parameter of the quality of fermented dairy products. For the production of the fermented milk drink, kombucha was used as a non-traditional starter. Two sweeteners were used, honey and sucrose. The aim of the work was to examine the influence of starter and sweetener on changes in the subsequent acidity and intensity of syneresis of the samples during storage. The results were compared with a control sample obtained by inoculation with a conventional starter culture. During storage, there was a drop in pH value and an increase in titratable acidity, as a result of the constant metabolic activity of the microflora and the production of lactic acid in the produced samples. Honey, as a sweetener, had an effect on the lower pH value of the fermented milk drink samples. The analysis of variance showed a statistically significant difference in the titratable acidity results and the intensity of syneresis of the samples during storage. Samples that were produced with kombucha as a starter showed better structure stability during storage and better quality. During storage, sample kb4 showed the best structural stability and the lowest intensity of syneresis.

KEYWORDS: stinging nettle extract; bioactive components; extraction; antioxidant

INTRODUCTION

Fermented dairy products are obtained by fermenting milk with lactic acid bacteria, yeasts, but it is also possible to use non-conventional starters such as komucha. In their research, many authors used kombucha for milk fermentation and the production of fermented milk products [1, 2, 3, 4, 5, 6, 7]. *Kombucha* is a symbiotic community of fungi and acetic acid bacteria, which, through metabolic activity on sweetened tea, produces a pleasant, slightly acidic drink that has many beneficial effects on human health. In addition to sucrose, other sweeteners, such as honey, can be used.

Honey has a long history of direct consumption in human nutrition, but it is also often used as a sweetener in many products to improve the aroma and structure of the product. This natural food has long been known for its nutritional and therapeutic aspects. The most important ingredients of honey are carbohydrates in the form of fructose, glucose, disaccharides and oligosaccharides, and the sweet taste of honey is given by components such as maltose, isomaltose, maltulose, sucrose [8].

Syneresis is used to describe the separation of whey on the surface of the product due to the tightening of the gel structure created by fermentation, which is a common problem and deficiency in the production and storage of yogurt.

There is no standardized analytical procedure for measuring syneresis, so it is determined by different methods based either on the principle of gravity or on the principle of centrifugal force [9]. The causes of syneresis can be numerous, and the most common are inadequate parameters during the technological process of beverage production. The development of the technology of fermented milk drinks improves and expands the range of high-quality functional food. It is known that the type of starter culture determines the nutritional, rheological and sensory properties of the fermented milk product.

Table 1. Sample of fermented milk drink

Sample	% of non-traditional starter inoculum	Starter culture	Sweetener	% of kombucha fermented milk drink as inoculum	
				kb1	kb2
kb1	10	-	sucrose	-	-
kb2	10	-	honey	-	-
kb3	-	-	-	10	-
kb4	-	-	-	-	10
kb	-	Lyofast Y 452	-	-	-

kb-kombucha

EXPERIMENTAL

MATERIALS

Kombucha culture grown on black tea was used for the fermentation process. The tea was prepared by adding 8 g of tea to 2 L of water at a temperature of 95°C. After 5 minutes, the tea was filtered, cooled to room temperature and divided into 2 equal parts. 70 g/L of sugar (sucrose) was added to one part, and 61.25 g/L of meadow honey to the other part, and mixed well. In both parts, 10 vol % starter (fermented tea) and were added (Table 1). Fermentation was carried out in a dark place (7 days/25°C) until the formation of a new biofilm of the kombucha culture, which later separated. After the formation of a sufficient number of kombucha, the milk fermentation process was started.

UHT milk with 2.8% m.f. produced by "Meggle" was used for the production of the fermented milk drink. The milk was inoculated with 10% inoculum of non-traditional starter culture in relation to the total amount of milk (kb1 and kb2) and inoculated milk (kb3 and kb4) with 10% of kombucha drink

Fermented milk drink kb was produced using a lyophilized (FD-DVS, Frozen dried Direct Vat Set) culture (manufactured by Sacco Clerici, Italy) Lyofast Y 452 E (composed of: *Lactobacillus delbrueckii ssp. bulgaricus* and *Streptococcus thermophilus*), while respecting all the culture manufacturer's parameters.

Fermentation of inoculated milk samples was carried out, with three times repetition, in a water bath at 34ºC, with monitoring of the pH value up to 4.6. Then the samples were cooled in ice water, packed in sterile glass packaging and stored at a temperature of +4ºC.

METHODS

DETERMINING pH VALUE

Active acidity was determined potentiometrically using a Testo 206 pH meter after the 1st, 7th, and 14th day of storage.

DETERMINING TITRATABLE ACIDITY

Titratable acidity was determined by Soxhlet-Henkel (°RH) after the 1st, 7th, and 14th day of storage.

DETERMINING SYNERESIS INTENSITY

Syneresis intensity was determined according to the modified method of Koegh and O'Keneedy [10] using a Tehtnica Železniki PLC 322 centrifuge. Samples of the fermented milk drink were centrifuged at 3000 rpm [11], and the volume of separated whey was expressed as ml of centrifuged/100 g of a sample [12].

STATISTICAL ANALYSIS

Statistical analysis (ANOVA) was performed using SPSS software (version 25), and Dunnet's test was used to assess statistical significance ($p<0.05$).

RESULTS AND DISCUSSION

Changes in the active and titratable acidity of the produced samples depending on the type of starter and sweetener are shown in Table 2. Table 3 shows results of syneresis intensity of the samples during 14 days storage.

During the storage of fermented dairy products, subsequent acidification of the curd occurs. Subsequent acidification is a consequence of the persistent metabolic activity of the product's microflora during its shelf life [13] and affects the appearance of whey syneresis [14]. The release of

whey is considered one of the most important parameters of the quality of fermented dairy products because it indicates certain errors in the production process.

In all samples of fermented milk drink, the pH value decreased linearly. During the first day of storage, the control sample (kb) and sample kb2, where honey was used as a sweetener, had the lowest pH value. According to the results, the samples in which honey was used as a sweetener had a lower pH value compared to the samples in which sucrose was used.

The reason for this may be the lower pH value of honey, which ranges from 3.2 to 4.5 depending on the type of honey [15].

According to literature data [16, 17], meadow honey has a pH above 4. In samples where kombucha was used as a starter, the drop in pH value was not statistically significant compared to the control sample ($p>0.05$), for all storage days. During storage, there was an increase in titratable acidity in all samples, which indicates the subsequent activity of the starter and the production of lactic acid in the produced samples. Analysis of variance showed that there is a statistically significant difference in titratable acidity for all days of storage.

Dunnett's test showed that there was a statistically significant difference between kombucha and control samples after the 1st, 7th and 14th day of storage, except for kb3 and kb (on the 1st day of storage) and kb3 and kb (on the 7th days of storage). Similar results were obtained by Makvandi et al. [6] in their study, who used Kombucha extract in different %(v/v).

Table 2. Average values and standard deviation of acidity of fermented milk drink during 14 days storage

Samples	pH			Acidity (°SH)		
	1 day	7 day	14 day	1 day	7 day	14 day
kb	4.41±0.05	4.23±0.14	4.11±0.14	29.60±0.1	31.70±0.17	33.60±0.05
kb1	4.48±0.02	4.31±0.01	4.18±0.01	30.80*±0.17	32.93*±0.05	34.50*±0.23
kb2	4.41±0.04	4.28±0.25	4.09±0.11	33.00*±0.08	34.63*±0.05	36.30*±0.1
kb3	4.48±0.03	4.35±0.07	4.2±0.20	30.16*±0.05	31.85±0.13	33.20*±0.00
kb4	4.45±0.13	4.23±0.09	4.18±0.02	29.80±0.13	32.13*±0.05	33.10*±0.00

kb-kombucha

**- the mean difference is significant at the 0,05 level*

Table 3. Average values and standard deviation of syneresis intensity of fermented milk drink during 14 days storage

Sample	Intensity of syneresis		
	1 day	7 day	14 day
kb	11.33±0.11	12.33±0.05	13.53±0.05
kb1	11.20±0.26	12.40±0.34	13.65±0.27
kb2	10.11*±0.07	11.35*±0.13	11.98*±0.12
kb3	8.90*±0.27	10.20*±0.18	11.95*±0.26
kb4	7.14*±0.09	8.25*±0.08	9.38*±0.04

kb-komucha

**- the mean difference is significant at the 0,05 level*

Looking at the results in Table 3, all samples showed an increase in syneresis during storage, analogous to a decrease in pH value and an increase in titratable acidity [18, 19] because proteins lose their ability to bind to water when pH is applied. and increased acidity which also contributes to syneresis.
Analysis of variance showed that there is a statistically significant difference in syneresis intensity for all days of storage, and Dunnett's test showed that there is a statistically significant difference between kombucha samples and control samples during storage. During storage, the sample kb4 had the lowest syneresis intensity. For the first day of storage, the sample kb had the highest intensity of syneresis, and after day 7 and 14, it was sample kb1. Based on the results, it can be concluded that the use of kombucha and honey is the best combination that contributes to the stability of the drink's structure and indicates a better product quality. Stijepic et al. [11] in their research showed a positive effect of adding honey to yogurt on viscosity and water retention capacity, i.e. on reducing the intensity of syneresis. Samples that had sucrose as a sweetener also showed acceptable values of syneresis intensity. Sweeteners, such as sucrose, high-fructose

corn syrup, or honey, are commonly added to blended yogurts to mask acidity for acidity-conscious consumers and, perhaps, to produce a firmer texture [20]. This is a very important fact considering that sucrose and honey were used as sweeteners here.

CONCLUSION

In all samples, pH value decreased linearly during storage. The addition of honey affected the lower pH value of the samples. During storage, there was an increase in titratable acidity in all samples, due to the still active starter and further formation of lactic acid in the produced samples. Due to the decrease in pH value and increase in titratable acidity, there was an increase in the intensity of syneresis during storage in all samples, analogously to a decrease in pH value and an increase in titratable acidity. Kombucha as well as sweeteners contributed to the stability of the structure as well as the better quality of the produced samples.

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