The Sensory Characteristics of Berry-Flavoured Kefir

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Abstract

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Certain physicochemical and sensory characteristics of the flavoured kefir drink were studied during refrigerated storage. Kefir drink batches were prepared using 2% addition of kefir grains, incubation for 18 h and subsequent filtration. The batches were then flavoured with blackberry, raspberry and strawberry aromas in the concentrations of 0.05, 0.10 and 0.15%, respectively. The samples were taken for analysis on 1st, 4th, 7th, and 10th days of storage at 4 ± 1°C. The sensory analysis of the flavoured kefir samples revealed the best acceptability level on the 4th day of storage. Nevertheless, the samples were acceptable all throughout the storage. The percentage of the aroma addition significantly influenced the odour, flavour, texture, and mouth-feel, and the overall acceptability ratings. The higher percentage of the added aroma the more sensed, however, the lowest aroma addition was preferable. The pHs of the flavoured kefir drinks decreased throughout the storage time whereas, the titratable acidity, alcohol content and CO_2 values increased.

Keywords: kefir; physicochemical parameters; sensory characteristics

Kefir is a unique and refreshing fermented milk product with defined health promoting benefits (Furukawa *et al*. 1990, 1991; Cevikbas *et al*. 1994; Zacconi *et al*. 1995; Zubillaga *et al*. 2001). The word of kefir is said to have originated from the Turkish word 'Keyif' for 'good feeling' due to the overall sense of health and well being when consumed. It originates in the Caucasus Mountains in the former Soviet Union, in Central Asia, and has been consumed as a traditional drink for thousands of years in these countries. In Turkey, kefir is currently available for retail sale; however, real kefir is produced only by traditional methods at home (Otles & Cagindi 2003).

Kefir is distinguished from the more known fermented milk yogurt in that it is the product of fermentation of milk carried out only with kefir grains or with mother cultures prepared from the grains. The grains contain a relatively stable and specific balance of a complex mixture of both bacteria and yeasts held together by a polysaccharide matrix. Out of the microbial components of the grains, the genera most frequently reported are homo-fermentative and hetero-fermentative lactobacilli, lactococci, leuconostoc, acetobacteria, and yeasts (both lactose-fermenting and non-lactose-fermenting) (Angulo *et al*. 1993; Garrote *et al*. 1998; Lin *et al*. 1999; Simova *et al*. 2002).

The lactic acid bacteria and yeast fermentation of milk results in the production of numerous components, including lactic acid, CO_2, a small amount of alcohol, and an array of aromatic molecules, all of which participate in providing kefir with its unique organoleptic characteristics; fizzy, slightly acidic and alcoholic taste, as well as the contents of antibiotics and bactericides that inhibit the growth of undesirable and pathogenic microorganisms in kefir milk (Anonymous 1992).

The ready-to-serve kefir drink contains lactic acid, mainly the L(+) form, of about 0.6–0.9%, as well as formic, succinic and propionic acids, 50% volume CO_2, 0.6–0.8% ethyl alcohol, different

aldehydes (propionic, acetic), and trace amounts of isoamyl alcohol and acetone (Libudzisz & Piatkiewicz 1990). Since lactose in milk is decreased by 75% after the fermentation, the people who are sensitive to lactose can safely consume the kefir drink.

The aroma components present are one of the parameters that are important for the consumers' acceptance of a product. The unique flavour of the traditional kefir results from the symbiotic metabolic activity of bacterial and yeast species in kefir grains.

Several studies have investigated general properties and health benefits of kefir, however, detailed studies are needed to increase the consumers' demand by improving kefir sensory characteristics through the addition of flavour components. Therefore, the article aims to determine the sensory characteristics of kefir flavoured with blackberry, raspberry, and strawberry aromas as shown in Table 1, and to evaluate the consumers' acceptance of fruit-flavoured kefir by a sensory panel.

MATERIAL AND METHODS

Materials. Kefir grains were provided by Uludag University, Department of Food Engineering, (Bursa, Turkey). Blackberry, raspberry, and strawberry aromas were purchased from AROMSA A.Ş. (Gebze, Turkey). Upon receipt, kefir grains were inoculated into pasteurised milk and incubated at 25°C until used. Grains were transferred three times per week.

Kefir sample preparation. For kefir drink to be analysed, pasteurised skim milk containing 0.15% fat was cooled down to room temperature, inoculated with 2% kefir grains, and incubated for 18 h at 23 ± 1°C until 4.6 pH. At the end of 18 h, kefir grains were separated by filtration through a plastic sieve (previously sterilised by immersion into ethanol (700 ml/l) and then washed with sterile water). Kefir drink was divided into four equal groups and filled into 200 ml bottles with reference to sample coding shown in Table 1. The bottles were capped, cooled down to 4–6°C and stored at 4 ± 1°C until the analysis. The samples were analysed on 1st, 4th, 7th and 10th days of storage (Table 2).

The titratable acidity and pH values of the samples were determined as described by Kurt *et al*. (1993). The amount of alcohol was determined according to the reactive index as stated by Official Methods of Analysis (2003), whereas CO_2 was evaluated by the titrimetric method (Anonymous 1988). Flavoured kefir samples were served for judging in small cups at 4 ± 1°C from the refrigerator. The sensory characteristics of the flavoured kefir drink were judged by 10 panelists after preliminary training sessions to instruct the panel, according to a modified method described by Muir *et al*. (1999), using the sensory rating scale of 1 to 5 (unacceptable/excellent). The judges were selected in the dependence on their availability and willingness to participate in the study. The experimental vocabulary was similar to that developed for profiling natural fermented milks (Irigoyen *et al*. 2005), and was modified for the berry-flavoured kefir samples. The list of attributes comprised three terms for odour (fruity, acid/sour, and creamy/milky), five flavour characteristics (intensity, fruity, sweet, acid/sour, and creamy/milky; flavour perceived in the mouth ranging from weak to strong, not added berry-like to added berry flavour like, not sweet to sweet, not sour/acid to sour/acid, and not creamy/milky to creamy milky), and four attributes encompassing texture and mouth-feel (viscosity, gummy/sticky, serum separation, and effervescence), and overall acceptability.

Statistical analysis. The analysis of variance (ANOVA) using 99% confidence intervals was run on each of the physicochemical and sensory

Table 1. Sample coding of flavoured kefir drinks

Code	Sample	Code	Sample
K1	standard kefir drink without any additional flavour components (control)	K3.2.	kefir drink with 0.10% raspberry flavour
K2.1.	kefir drink with 0.05% blackberry flavour	K3.3.	kefir drink with 0.15% raspberry flavour
K2.2.	kefir drink with 0.10% blackberry flavour	K4.1.	kefir drink with 0.05% strawberry flavour
K2.3.	kefir drink with 0.15% blackberry flavour	K4.2.	kefir drink with 0.10% strawberry flavour
K3.1.	kefir drink with 0.05% raspberry flavour	K4.3.	kefir drink with 0.15% strawberry flavour

Table 2. Changes in physicochemical values in flavoured kefir samples made with blackberry, raspberry, and strawberry aromas during storage

Sample	Storage time (days)	pH	Titrable acidity (%)	Alcohol (%)	CO_2 (%)
K1.	1	5.23	0.25	0.34	132.40
	4	4.82	0.67	0.65	242.004
	7	4.67	0.76	0.82	259.60
	10	4.31	0.83	1.03	286.00
K2.1.	1	5.25	0.25	0.44	131.00
	4	4.81	0.68	0.60	237.60
	7	4.68	0.73	0.82	276.20
	10	4.27	0.80	1.21	292.00
K2.2.	1	5.22	0.38	0.34	144.00
	4	4.80	0.73	0.51	235.40
	7	4.71	0.77	0.99	278.00
	10	4.32	0.82	1.21	289.20
K2.3.	1	5.18	0.26	0.44	132.00
	4	4.78	0.73	0.65	224.40
	7	4.76	0.77	1.03	274.00
	10	4.38	0.83	1.21	288.40
K3.1.	1	5.23	0.58	0.44	135.40
	4	4.73	0.68	0.82	244.80
	7	4.70	0.76	1.03	280.00
	10	4.27	0.87	1.21	292.00
K3.2.	1	5.19	0.59	0.51	146.40
	4	4.73	0.65	0.82	240.80
	7	4.69	0.76	0.91	275.00
	10	4.22	0.87	1.21	283.00
K3.3.	1	5.38	0.55	0.51	130.00
	4	4.75	0.62	0.82	233.20
	7	4.67	0.74	1.03	278.00
	10	4.24	0.83	1.21	285.00
K4.1.	1	5.28	0.36	0.51	147.40
	4	4.85	0.63	0.82	257.40
	7	4.75	0.74	1.03	279.40
	10	4.33	0.77	1.21	286.00
K4.2.	1	5.24	0.44	0.45	137.00
	4	4.78	0.63	0.60	259.60
	7	4.71	0.74	0.91	282.80
	10	4.25	0.83	1.21	288.00
K4.3.	1	5.26	0.58	0.60	131.00
	4	4.76	0.67	0.82	259.40
	7	4.70	0.72	0.91	276.00
	10	4.24	0.84	1.03	287.00
P		*	*	*	*

*significant at $P < 0.01$

variables to disclose possible differences between the samples for the two factors "aroma addition" and "storage time". All analyses were performed using the MSTAT statistical package version 10.0. The correlation analysis was carried out for the different sensory attributes evaluated.

RESULTS AND DISCUSSION

Table 2 presents the values of the main physicochemical parameters in flavoured kefir drink samples made with blackberry, raspberry, and strawberry aromas at three different concentrations during 10 days storage. Kroger (1993) reported that the gross composition and caloric value of kefir are identical to those of the initial milk, except for the conversion of lactose to lactic acid and ethanol. Kwak *et al*. (1996) observed a depletion of lactose and a decrease in the pH value during lactic acid fermentation as well as the utilisation of lactose with other sugars present for the production of ethanol during alcohol fermentation by yeast. In the current study on flavoured kefir, it was found that the aroma usage and the storage period significantly effected the physicochemical parameters (Table 2) ($P < 0.01$).

The pH values of the flavoured kefir drinks decreased throughout the storage time. Even though the grains were separated from the fermented milk by filtration prior to the aroma addition and storage, some lactic acid bacteria and yeast cells might pass into the eluate and the fermentation might continue during the storage leading to an increase in acidity and a decrease in pH. The variation in pH and titratable acidity values of flavoured kefir samples showed similarity with the findings of other researchers concerned with unflavoured kefirs (Garg 1989).

One of the important steps during sequential activity of bacteria and yeasts for the kefir production is the alcohol fermentation. Depending on the fermentation process, fermentation temperature, time and type of the culture used, the alcohol content of kefir vary from 0.06%, up to a maximum of 3% alcohol (Koçak & Gürsel 1981; Ergüllü & Üçüncü 1983; Marshall 1984; Duitschaever *et al*. 1988; Koroleva 1988; Guzel-Seydim *et al*. 2000) and increases during storage. Konar and Şahan (1989) stated that the CO_2 content in kefir produced using different milks ranges between 0.93 and 2.77 g/l.

Sensory analysis

Table 3 presents the mean values of sensory attributes in flavoured kefir drink samples during 10 days storage.

Even though the ratings of the sensory parameters did not range within wide limits, they were significantly affected by the storage time. Odour, flavour, texture, and mouth-feel as well as the overall acceptability ratings were highest in all samples on 4th day of storage, and decreased until 10th day. The panel could sense the fruit aromas from the 1st until 10th day of storage. The higher the percentage of the aroma added, the more sensed; however, the lowest aroma addition was preferable.

Studying two kefir samples over a 5-day storage period, Kilic *et al*. (1999) found that the scores of all the sensory attributes decreased significantly

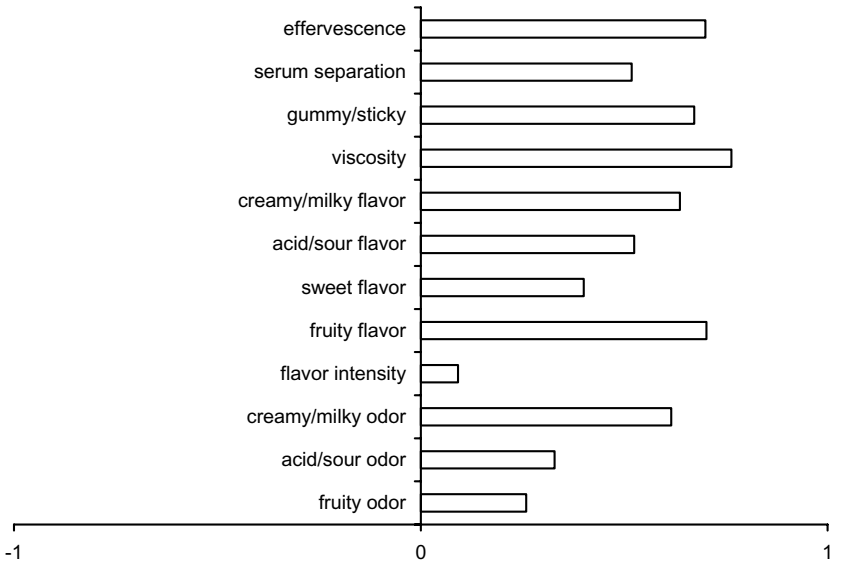

Figure 1. Correlations between sensory attributes and overall acceptability of flavoured kefir samples

Table 3. Mean odour, flavour, texture, and mouth-feel, and overall acceptability ratings of flavoured kefir drinks made using different percentage (0.05, 0.10, and 0.15%) of the added blackberry, raspberry, and strawberry aromas from the sensory panel

Sample	Storage time (days)	Odour			Flavour					Texture and mouth-feel				Overall acceptability	*P*
		fruity	acid/sour	creamy/milky	intensity	fruity	sweet	acid/sour	creamy/milky	viscosity	gummy/sticky	serum separation	effervescence		
K2.1.	1	3.6	4.2	4.2	4.9	4.0	4.8	4.5	4.1	4.8	4.7	4.5	4.0	52.3	*
	4	4.4	4.2	4.0	4.5	4.2	4.5	4.6	4.2	4.8	4.7	4.6	4.3	53.0	*
	7	4.2	4.4	4.0	4.8	4.9	4.0	3.2	4.3	4.4	4.0	4.2	4.2	50.6	*
	10	4.6	3.6	4.8	4.0	4.4	4.7	3.6	4.4	4.6	4.4	4.5	4.1	51.7	*
K2.2.	1	3.5	3.0	4.0	3.0	3.3	3.0	3.6	3.7	2.9	4.5	5.0	4.8	44.3	*
	4	4.2	4.5	4.6	4.5	4.4	4.2	4.4	4.5	4.7	4.5	4.9	4.7	54.1	*
	7	4.4	4.1	3.9	3.5	3.5	3.8	4.2	4.4	3.2	4.0	4.5	4.0	47.5	*
	10	4.6	4.4	3.7	4.2	4.5	4.1	3.7	4.1	3.9	3.8	3.2	3.8	48.0	*
K2.3.	1	4.4	3.5	3.8	3.6	3.8	4.0	4.2	3.8	3.5	5.0	5.0	4.7	49.3	*
	4	3.7	3.8	4.1	4.3	4.4	4.5	4.6	4.8	4.2	4.1	4.7	4.5	51.7	*
	7	4.5	3.9	4.7	4.2	4.5	4.9	3.5	4.6	4.2	4.5	4.0	4.0	51.5	*
	10	4.0	3.6	4.2	4.0	4.0	4.5	3.2	4.6	4.0	4.0	4.5	4.0	48.6	*
K3.1.	1	4.5	3.5	3.2	3.8	3.7	4.0	4.0	3.5	4.0	4.5	4.9	5.0	48.6	*
	4	4.6	4.8	4.9	4.7	4.5	4.8	4.5	4.5	4.7	5.0	5.0	4.5	56.5	*
	7	4.8	.42	4.1	4.6	4.6	4.2	4.2	4.7	3.8	4.2	4.0	4.2	51.6	*
	10	4.7	4.0	4.8	4.8	4.6	4.1	4.2	4.6	3.8	4.0	4.0	4.1	51.7	*
K3.2.	1	4.6	3.9	3.5	4.5	4.3	4.4	4.6	4.2	4.5	4.9	4.9	4.8	53.1	*
	4	5.0	4.4	4.8	4.9	4.6	4.9	4.2	4.4	4.6	4.6	4.7	4.7	55.8	*
	7	4.7	4.1	4.8	4.2	4.6	4.7	4.4	4.7	4.2	4.0	4.5	4.2	53.1	*
	10	4.7	4.0	4.5	4.0	4.7	4.6	4.2	4.6	4.1	3.8	4.2	4.2	51.6	*
K3.3.	1	4.4	4.2	4.3	4.4	4.1	4.5	4.0	3.8	4.5	4.8	4.5	4.4	51.9	*
	4	4.6	4.5	4.2	4.0	4.3	4.0	3.9	4.5	4.2	44	5.0	4.5	52.1	*
	7	5.0	4.0	4.7	4.8	4.7	4.8	4.6	4.8	4.3	4.0	3.5	4.2	53.4	*
	10	5.0	3.8	4.7	4.5	4.7	4.9	4.5	4.7	4.0	3.8	3.2	4.0	51.8	*
K4.1.	1	3.8	4.0	4.2	4.0	3.8	4.0	4.0	3.8	4.9	4.9	5.0	5.0	51.4	*
	4	4.8	4.4	4.8	4.9	4.9	4.2	4.5	4.7	4.9	4.9	5.0	4.7	56.7	*
	7	4.4	3.8	4.6	4.4	4.7	3.8	4.0	4.2	4.0	4.0	4.1	4.2	51.1	*
	10	4.6	3.5	4.5	4.5	4.8	3.5	3.9	4.0	3.8	4.0	4.0	4.6	49.7	*
K4.2.	1	4.0	4.0	4.2	4.3	4.1	4.0	3.9	4.0	4.0	4.5	4.5	4.2	49.7	*
	4	4.5	4.6	4.6	4.5	4.7	4.5	4.4	4.5	4.5	4.5	4.8	4.9	55.0	*
	7	4.0	4.2	4.2	4.4	4.5	4.0	4.2	4.1	4.0	4.1	4.2	4.0	49.9	*
	10	4.2	4.0	4.1	4.0	4.2	3.9	4.2	4.0	4.0	3.9	4.0	3.8	49.0	*
K4.3.	1	3.8	3.7	4.2	4.0	4.0	4.1	4.2	4.0	4.1	3.8	4.0	4.0	47.9	*
	4	4.0	4.0	4.1	4.2	4.0	4.3	4.5	4.0	4.2	4.4	4.2	4.4	50.3	*
	7	4.0	3.9	3.8	4.0	4.0	4.1	4.2	4.3	4.0	4.0	4.0	4.2	48.5	*
	10	4.5	4.0	3.9	4.1	4.0	3.9	4.0	4.2	4.0	3.8	4.0	4.0	48.4	*

*significant at $P < 0.01$

with time, and they concluded that kefir kept under refrigeration should be consumed within 3 days from the manufacture. In the current study, the samples of 4 day-matured kefir made using 0.05% strawberry aroma added had higher sensory ratings than other aroma-added samples during storage. Flavour intensity increased during storage in contrast to the acceptability of the product to the panelists. Acid/sour or fermented odour was masked with the fruit aromas resulting in more acceptable drinks for the consumption. The correlations between different sensory attributes and the acceptability indicated that the panel was positively influenced by the fruit odour and taste that masked the acid/sour flavour (Figure 1). The panelists were not asked to compare the kefir samples with fresh kefir of dominant creamy/milky odour and taste. It was mentioned that the judges were negatively influenced by the acid/sour odour and flavour sensed after 4th day of maturation/storage (Table 3). The results obtained for certain attributes agreed with the results reported by Muir *et al*. (1999) who studied the sensory profiles of various fermented milk products including kefir, and Irigoyen *et al*. (2005) who examined the microbiological, physicochemical, and sensory characteristics of kefir during storage.

It appears that the panelists preferred kefir with a slightly acidic/alcoholic taste and odour instead of higher acidity. Masking acid/sour taste with fruit flavour additions, panelists who are used to fresh creamy/milky taste kefir consumption tend to like kefir with higher acidity.

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