

THE MINERAL CONTENT OF KEFIR COMMERCIALY PRODUCED IN TURKEY

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Abstract

Dairy products are regarded as important mineral sources and therefore, it is of significance to determine the mineral composition of fermented milk products. In this study, the mineral composition of plain kefir as well as kefir containing strawberry and mixed berry types commercially produced in Turkey was evaluated. No differences in the Ca, P and Fe levels among the kefir samples were detected. On the other hand, K and Na levels were found to be higher in mixed berry kefir than that of plain and strawberry kefir, while the lowest Mg and Zn concentrations were detected in mixed berry kefir ($p < 0.05$). The highest Cu level was found in plain kefir, while the lowest Cu level was detected in mixed berry kefir samples ($p < 0.05$). The variations in the mineral composition of the different kefir samples might be due to the variation in the supplements used in the different types of kefir.

Key words: mineral composition, kefir

1. INTRODUCTION

Dairy products are recognized as excellent sources of essential nutrients such as proteins, lipids, vitamins and also minerals. Nowadays, with the increase of the consumers' interest towards the nutritional composition of the food commodities, the evaluation of the health benefits and nutritional content of food products is gaining more and more importance.

Kefir, originally made in the Caucasus region, is a fermented milk product that is slightly carbonated, with mild acidic taste. Nowadays, kefir is produced not only in the Middle East, the Balkans, but is widely consumed in Eastern and Northern Europe, North America, and North Africa (Sarkar 2007). The name of this fermented milk products is known to originate from the word "keyif" which in Turkish means "feeling good" (Otles & Cagindi 2003, Sarkar 2007).

The fermentation of kefir is induced by small, white, cauliflower-shaped masses named kefir grains (Fontan et al. 2006, Sarkar 2008). Kefir grains have been found to consist of different species of lactic acid bacteria, acetic acid bacteria and yeasts mainly entrapped in protein and polysaccharide matrix (Witthuhn, Schoeman & Britz 2005). Kefir grains are known to contain bacterial species such as *Lactobacillus*, *Lactococcus*, *Leuconostoc*, *Streptococcus*, *Acetobacter*, *Bifidobacterium* spp. and yeasts such as *Saccharomyces*, *Zygosaccharomyces*, *Kluyveromyces* and *Candida* spp. (Fontan et al. 2006, Guzel-Seydim et al. 2011, Latorre-Garcia, Castillo-Agudo & Polaina 2007). Most of these microorganisms are recognized as probiotics (Kaur, Chopra & Saini 2002).

Recently, kefir has gained a considerable significance and therefore, this fermented dairy product has been produced industrially in appreciable amounts throughout the world mainly due to its exceptional nutritional and functional properties (Guzel-Seydim et al. 2011, Otles & Cagindi 2003, Sarkar 2007). As stated above, kefir is recognized as a good source of probiotics, that have beneficial health effects such as improvement of the gastrointestinal system. Furthermore, kefir has been found to have antibacterial, antimutagenic, and anticarcinogenic effects. Thus, based on these properties, the consumption of kefir was found to improve the immune system, the gastrointestinal system and to have cholesterol lowering effects (Guzel-Seydim et al. 2011, Otles & Cagindi 2003, Sarkar 2008).

Based on the fermentation process, some prebiotics favoring the proliferation of the probiotics within the gastrointestinal system are also produced during kefir processing (Guzel-Seydim et al. 2011). Furthermore the amount of conjugated linoleic acid present in fermented dairy products has been related to anticarcinogenic and antiatherogenic properties and other human beneficial effects (Haro, Artacho & Cabrera-Vique 2006). Fermented milk products have also been proved to be important mineral sources, especially for lactose-intolerant patients and thus, kefir has been determined to improve the lactose tolerance in adults with lactose maldigestion (Hertzler & Clancy 2003). Kefir is also recommended for infants over 6 months (Sarkar 2007)

Traditionally, the production of kefir is explored by inoculating milk with a mixed culture designated as kefir grains. Nowadays, to enable the industrial production, the traditional processing of kefir has been improved by preparing a bulk culture for the further inoculation of heat-treated-milk (Fontan et al. 2006, Sarkar 2008, Witthuhn, Schoeman & Britz 2005).

Since dairy products are designated to have a considerable nutritional significance, in literature, there a number of reports analyzing the nutritional composition of dairy products. The nutritional evaluations have shown that the characteristics of dairy products are greatly affected by the type of milk, different breeds and genetic factors, feeding type, type of manufacturing, as well as the supplements and adjuncts used during the production process (Erkaya & Sengul 2012, Ozcan 2010, Raynal-Ljutovac et al. 2008).

Dairy products are recommended as important mineral sources not only because they are rich in minerals, but also due to the fact that the bioavailability of the minerals in these products are higher (Kitts and Kwong 2004, NRC 1989, Unal, El & Kilic 2005). Nowadays, to increase the acceptability of the products and also to produce products with improved functional characteristics there is an increasing trend to supplement some fruits into milk, yoghurt and fermented dairy products. Berries are designated to have important functional properties because they are good sources of a number of bioactive compounds such as vitamins and phenolics having an antioxidant activity (Hannum 2004, Paredes-Lopez et al. 2010) Although, a considerable number of reports presenting the mineral contents of dairy products have been published up to now, there is limited research about the mineral composition of kefir products. Gulen, Kizilkaya & Cevik (2013) determined the mineral composition of kefir produced from cow and goat milk, while Ozcan (2010) evaluated the mineral content of industrially produced kefir samples collected from the markets in Turkey.

Taking into consideration the importance of the nutritional evaluation of fermented dairy products, the aim of the present study was to determine the mineral composition of industrially produced plain kefir, kefir supplemented with strawberries and with mixed berries.

2. MATERIALS AND METHODS

2.1. Materials

Standard solutions of Ca, P, K, Na, Mg, Cu, Fe and Zn (Merck, Darmstadt, Germany) were used for the mineral determination of the samples. The solutions were diluted to obtain the working standards. All reagents used during the analyses were of analytical grade and obtained from Merck (Darmstadt, Germany). Kefir produced from cow milk as the main raw material and kefir produced from cow milk supplemented with strawberry and mixed berry fruits were used for the mineral analysis. Kefir samples were collected monthly for 5 consecutive months from May to September 2012 from the retail markets in Canakkale, Turkey.

2.2. Mineral analysis

To decrease the risk of contamination, the use of glassware was reduced to minimum and polypropylene tubes were used. All the materials were washed first with 65% HNO₃, and then rinsed with bi-distilled deionized water.

For the determination of Ca, P, K, Na, Mg, Cu, Fe and Zn, the samples were digested with HNO₃ / HCl (2:1) (Aydin 2008). Then, the mineral contents were determined using a Perkin Elmer (Optima 8000) inductively coupled plasma - optical emission spectrometer (ICP-OES). The operating parameters of the equipment are given in Table 1. The mineral composition of each sample was measured in triplicate. The mineral contents of the samples were expressed as mg mineral per L. The results were reported as the means ± standard deviation.

Table 1. Instrument operating parameters for ICP-OES

Parameter	Description
Rf power	1.30 kW
Plasma gas flow rate	2.0 L/min
Auxiliary gas flow rate	0.2 L/min
Nebulizer gas flow rate	0.55 L/min
Sample uptake rate	1.5 mL/min
Argon gas (high purity)	99.99%
Torch type High solids	axiel (1.8 mm, quartz)
Nebulizer type	Concentric glass; cyclonic spray chamber
Nebulizer pressure	200 kPa
Pump rate	1.5 mL/min
Replicates	3
Sample uptake delay	30 s

2.3. Statistical analysis

The results were statistically analyzed using the Statgraphics Centurion XV software. Significant differences among the means were determined by the Duncan test. The values were considered to be significantly different at $p < 0.05$.

3. RESULTS AND DISCUSSION

Dairy products are known to be significant sources of nutrients such as minerals. Therefore, the determination of the mineral composition of these products is of crucial importance for their nutritional evaluation.

The mineral contents of the kefir samples analyzed within the present study are given in Table 2. As can be seen from the results, the samples show considerable variability. This variability might be mainly due to the different composition of the raw milk used in the production of kefir, the different supplements used in the production of kefir, the production technology as well as the processing and fermentation conditions.

Table 2. The mineral composition of the kefir samples*

	Plain Kefir			Kefir Supplemented with Strawberries			Kefir Supplemented with Mixed Berries		
	Min.	Max.	Mean $\pm$ SD**	Min.	Max.	Mean $\pm$ SD	Min	Max.	Mean $\pm$ SD
Macrominerals									
Ca	1716.1	1890.2	1820.1 $\pm$ 77.1	1850.8	1913.2	1883.1 $\pm$ 21.1	1702.5	1720.9	1711.5 $\pm$ 9.2
P	1313.8	1452.5	1394.0 $\pm$ 59.9	1416.5	1468.2	1440.0 $\pm$ 17.6	1302.5	1317.4	1309.3 $\pm$ 7.5
K	1162.7	1190.8	1178.3 $\pm$ 12.3 a	1229.2	1341.8	1287.4 $\pm$ 45.9 a	2182.3	2248.7	2205.5 $\pm$ 37.5 b
Na	152.2	239.2	191.6 $\pm$ 42.8a	152.3	155.5	153.5 $\pm$ 1.1a	383.0	388.1	385.5 $\pm$ 2.5b
Mg	223.2	243.1	235.3 $\pm$ 7.2a	224.4	277.5	249.9 $\pm$ 19.9a	153.5	161.4	156.4 $\pm$ 4.3b
Microminerals									
Cu	0.81	0.90	0.86 $\pm$ 0.04a	0.55	0.74	0.67 $\pm$ 0.07b	0.42	0.55	0.52 $\pm$ 0.06c
Fe	2.15	3.36	2.75 $\pm$ 0.59	1.94	12.10	7.01 $\pm$ 5.47	3.10	4.45	3.62 $\pm$ 0.75
Zn	5.62	5.90	5.75 $\pm$ 0.12a	5.93	6.61	6.21 $\pm$ 0.24a	2.55	2.72	2.62 $\pm$ 0.08b

* The results are presented as mean $\pm$ standard deviations with three replicates.

** Different letters in one row denote a significant difference among the values ($p < 0.05$).

In general, dairy products are known to contain considerable amounts of calcium and phosphorus. Ca and P are found in dairy products mainly in the form of calcium phosphate. These minerals are essential for the bone formation. On the other hand, Ca is significant in the regulation of cell membrane permeability, promotion of muscle contraction and blood clotting. P is not only important for bone formation, but has also a significant role in the metabolic processes (Kitts & Kwong 2004). In this study, the Ca concentrations of the analyzed samples were found to be in the range of 1702.5 and

1913.2 mg/L, while the P concentrations varied between 1302.5 and 1468.2 mg/L. Although there was no statistical difference among the Ca and P contents of the samples, the Ca and P composition of kefir supplemented with mixed berries was slightly lower than the other samples. The mineral composition of dairy products is mostly affected the type of the milk used, the production technology and also the adjuncts used during the production process. Gulen, Kizilkaya & Cevik (2013) found out that the mineral contents of kefir were higher than that of the specific milk samples. Similarly, Erkaya & Sengul (2012) found out that the Ca and P concentrations of yoghurt were higher than those of the milk samples.

Generally, the ratio of Ca/P in milk and yoghurt is found to be around 1.3 (Kitts & Kwong 2004, Raynal-Ljutovac et al. 2008). In this study, this ratio for the analyzed kefir samples was estimated to be 1.31. Similarly, Gulen, Kizilkaya & Cevik (2013) estimated this ratio to be 1.32 for kefir made from either goat or cow milk.

The potassium composition of the kefir samples was in the range of 1162.7 – 2248.7 mg/L. The K level of the various kefir samples varied significantly and kefir supplemented with mixed berries was found to contain higher K content than plain kefir and kefir supplemented with strawberries ($p < 0.05$). The higher content of the kefir containing mixed berries might be due to the higher K content of the fruits used in the product. K is known to play a significant role in the regulation of osmotic pressure, formation of collagen and also in the transmission of nerve impulses (NRC 1989).

The Na levels of the samples analyzed within this study were found to vary between 152.2 and 388.1 mg/L. Similar to the K level of the samples, the Na concentration of kefir supplemented with mixed berries was found to be significantly higher than the other samples ($p < 0.05$). Sodium is known to be significant in the human body for the regulation of osmotic pressure and also for the acid-base balance (NRC 1989).

In human nutrition, magnesium is an important macromineral, since it is required for many biosynthetic processes, as well as the nucleic acid and protein metabolism. Magnesium is also known to be associated with the regulation of heart muscles (Gropper & Smith 2009). The Mg levels of the kefir samples were found to be in the range of 153.5 and 277.5 mg/L. No significant changes were observed between plain kefir and kefir supplemented with strawberries. On the other hand, the Mg content of kefir supplemented with mixed berries was found to be significantly lower than plain kefir and kefir supplemented with strawberries ($p < 0.05$).

The copper levels of the kefir samples varied between 0.42 and 0.90 mg/L. The Cu contents of the samples were found to be significantly different among the kefir samples. The highest Cu content was detected in plain kefir, while the lowest was found in kefir supplemented with mixed berries ($p < 0.05$). For human nutrition, copper is designated as a micromineral, that is known to act as a cofactor of enzymes involved in various metabolic processes within living cells. Additionally, copper is required for the prevention of anemia, skeletal effects and degeneration of the nervous system (NRC 1989). On the other hand, higher amounts of copper may lead to some abnormalities. Therefore the required Cu amounts for human body are not well-differentiated.

In general, dairy products are not defined to be important sources of iron. The iron content in milk and dairy products is greatly influenced by the type of feeding and may show considerable variability (Cashman 2003). The Fe levels of the kefir samples analyzed within this study were determined to be in the range of 2.15 – 12.10 mg/L. Because a significant difference among the standard deviations of the means of the Fe concentrations of the samples was detected, no difference among the Fe level of the samples was found.

Zinc is considered as an essential microelement, because it plays an important role in human metabolism and acts as a cofactor of some enzymes involved in metabolic reactions. Usually, milk and

dairy products are regarded as important Zn sources. Therefore, it is of significance to evaluate the Zn levels of the kefir samples. The Zn concentrations of the kefir samples were found to vary between 2.55 and 6.61 mg /L. The Zn content of kefir supplemented with mixed strawberries was found to be significantly lower than that of plain kefir and kefir supplemented with strawberries ($p < 0.05$).

In this study, the mineral composition of industrially produced types of kefir was evaluated.

4. CONCLUSION

Fermented dairy products nowadays are considered as important mineral sources especially for patients suffering from lactose-intolerance. In this study, the mineral composition of plain kefir, and kefir supplemented with berry fruits was evaluated. Kefir supplemented with mixed berries was found to contain higher amounts of K and Na. Dairy products supplemented with fruits might serve also as sources of important functional bioactive compounds. Thus, in the future studies, the functionality of such products might be investigated.

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