GIDA (2016) 41 (5): 317-321
doi: 10.15237/gida.GD16032

Research / Araştırma

MINERAL AND HEAVY METAL CONTENT IN CAMİ BOĞAZI CHEESE ON SALE IN TRABZON, TURKEY

Asya Çetinkaya[1*], Giray Buğra Akbaba[2], Sibel Özçakmak[3], Güven Gülbaz[3]

[1, 4] Kafkas University, Faculty of Engineering and Architecture, Department of Food Engineering, Kars, Turkey
[2] Kafkas University, Faculty of Engineering and Architecture, Bioengineering Department, Kars, Turkey
[3] Food, Agriculture and Livestock Directorate, Samsun, Turkey

Received / Geliş Tarihi: 27.12.2015
Received in revised form / Düzeltilerek Geliş Tarihi 22.02.2016
Accepted / Kabul Tarihi 27.02.2016

Abstract

The objective of this study was to determine the levels of certain minerals and heavy metals in 15 samples of locally produced Cami Boğazı cheese collected from cheese shops and district bazaars in Trabzon province, Turkey and evaluate whether the levels are within the acceptable limits given in the Turkish Food Codex. Using Inductively Coupled Plasma Optical Emmision Spectrometry, the average levels of the mineral substance and heavy metals in the Cami Boğazı cheese samples were determined as; calcium 3573.40±249.61 mg/kg, potassium 452.13±25.31 mg/kg, sodium 8413.31±506.59 mg/kg, magnesium 164.23±8.97 mg/kg, iron 0.37±0.17 mg/kg, zinc 27.52±1.85 mg/kg, copper 1.350±0.10 mg/kg, manganese 0.15±0.09 mg/kg, phosphorus 4272±269.90 mg/kg, lead 0.179±0.03 mg/kg and cadmium 0.028±0.001 mg/kg. These results show that the mineral content and heavy metal levels of the cheese samples were within the limits for certain foodstuffs (such as raw milk and heat-treated milk, hocafish, canned foods, beef and mutton) given in the Turkish Food Codex. This is the first report on the mineral and heavy metal content in Cami Boğazı cheese.

Keywords: Cami Boğazı cheese, mineral substance, heavy metal, ICP-OES

TRABZON'DA TÜKETİME SUNULAN CAMİ BOĞAZI PEYNİRLERİNİN MİNERAL MADDE İÇERİĞİ VE AĞIR METAL KONTAMİNASYONU

Özet

Araştırma, Trabzon ilindeki peynir pasajları ve semt pazarlarından toplanan 15 adet Cami Boğazı peynirinde mineral madde ve ağır metal içeriklerinin belirlenmesi amacıyla yapılmıştır. Araştırmada, küçük mandıra ve aile tipi işletmelerde üretilip Trabzon ilinde tüketime sunulan Cami Boğazı peynirinde bazı mineral madde ve ağır metal düzeylerinin belirlenmesi ve Türk Gıda Kodeksi'nde belirtilen limitlere uygunluğunun tespit edilmesi amaçlanmıştır. Mineral madde ve ağır metal içerikleri ICP-OES kullanılarak sonuçlar mg/kg cinsinden verilmiştir. Ortalama mineral madde ve ağır metal içerikleri; kalsiyum 3573.40±249.61 mg/kg, potasyum 452.13±25.31 mg/kg, sodyum 8413.31±506.59 mg/kg, magnezyum 164.23±8.97 mg/kg, fosfor 4272±269.90, demir 0.37±0.17 mg/kg, çinko 27.52±1.85 mg/kg, bakır 1.350±0.10 mg/kg, mangan 0.15±0.09 mg/kg, kurşun 0.179±0.03 mg/kg ve kadmiyum 0.028±0.001 mg/kg olarak tespit edilmiştir. Sonuç olarak, peynir numunelerinin ağır metal seviyelerinin Türk Gıda Kodeksi'nin çiğ süt ve ısıl işlem görmüş süt, balık, konserve gıdalar, sığır ve koyun eti vb bazı gıdalar için belirlediği sınırlar içerisinde olduğu belirlenmiştir. Bu makale, Cami Boğazı peynirindeki mineral madde içeriği ve ağır metal varlığı hakkındaki ilk rapordur.

Anahtar kelimeler: Mineral madde, ağır metal, Cami Boğazı Peyniri, ICP-OES

* Corresponding author /Yazışmalardan sorumlu yazar;
a_cetinkaya36@hotmail.com, (+90) 474 225 1279, (+90) 474 225 1282

INTRODUCTION

Cami Boğazı cheese is a traditional type of cheese produced in Trabzon, Turkey. In the production of this cheese, first, white cheese produced from cow's milk is melted and kneaded in boiled whey, then it is chopped and mixed with salt and cheese curds usually made from buttermilk and known as Minci (Minzi) in the Black Sea region (1).

After a maturation period of few months in wooden barrels, cheese is ready for consumption. Due to their nutritional content, milk and dairy products are indispensable for human beings (2). Cheese is the most commonly produced dairy product and most people enjoy consuming it. Almost all types of cheese have a high nutritional value, being rich in milk fat, fat-soluble vitamins and minerals. They also contain significant amounts of calcium and phosphorous; the consumption of 100 g of hard cheese is sufficient to meet the daily calcium and phosphorous requirements for an adult and the same amount of soft cheese meets 50% of this requirement (3, 4). With regard to their amounts, minerals in the milk are divided in two groups: macro elements such as calcium, magnesium, chlorine and sodium and trace elements including iron, zinc, copper, chrome, aluminum, and manganese (2). In the first group, calcium, phosphorous, magnesium, sodium and potassium are all of great significance to nutritional physiology. In addition, these minerals stabilize the chemical structure of milk proteins, promoting the effects of the rennin enzyme on the casein complex, and play an essential role in resistance to heat treatment and flavor formation in certain dairy products (5). Furthermore, calcium has significant involvement in blood clotting, enzyme activation, regulation of cellular development and insulin secretion. Magnesium is imperative for muscle and nerve conduction and phosphorus is important for bone and teeth structure (5, 6). The mineral content of cheese varies depending on the species and breed of the animal, lactation status, presence of udder diseases, nutrition of the animal, seasonal variations and genetic factors (5).

Some of the heavy metals necessary for the functioning of enzyme systems (eg., iron, copper and zinc) are of particular importance while the role of some others is yet to be identified (7). For example, zinc plays a significant role in major aspects of maintaining the human body, such as the preservation of olfaction, development of a healthy immune system, the production of proteins, secretion of enzymes, and the production of DNA (8). Depending on its level, heavy metal intake during food consumption leads to various irregularities in functions and damage to the body. These substances lead to disturbances, such as a lack of appetite, labored breathing, loss of memory, sleep and nervous system disorders. Furthermore, heavy metals are involved in cardiovascular and circulatory system diseases, which may lead to cancers, anemia, intoxication and premature death. The rate of heavy metal deposition in the body varies, depending on the chemical forms of heavy metals, age and nutrition (9, 10). Metal residues are not present in the natural structure of foods but they contaminate foods in various ways. This contamination can result from the equipment used or packaging materials with which the food products come into contact during production and storage. The contamination of these products may also be a result of the transfer to the raw material from a contaminated environment. Some heavy metals can accumulate in plants and then be absorbed into animal fat (11). Milk and dairy products contain low levels of heavy metals, which may increase due to contamination. The heavy metal contamination in milk and dairy products can result from contamination in lactating animals or from the machines and equipment with which dairy products come into contact during production and storage (12). Copper, zinc, iron, tin, lead, arsenic and cadmium are major elements present in metallic contamination, due to metal canisters or service water used during the technological processing or storage of milk and dairy products. The dissolution of metals in the composition of these canisters creates a higher risk of contamination for acidic products such as cheese and milk when compared with other products (2).

Contaminants from various sources are considered to be health hazards by environmental organizations. Among the issues concerning FAO/WHO are problems created by the contamination of foodstuffs with heavy metal ions and the increase of contamination beyond daily tolerance levels (13). Therefore, this study determined the levels of calcium, potassium, sodium, magnesium,

phosphorous, manganese, iron, zinc, copper, cadmium and lead in Cami Boğazı cheese marketed in cheese shops and district bazaars in Trabzon.

MATERIAL and METHODS

Sample Collection

Fifteen samples of locally produced Cami Boğazı cheese were obtained from cheese shops and district bazaars in Trabzon. The samples were transported to the laboratory using cold chain, and stored at 4±1 °C until the time of analysis.

Methods

Sample Preparation:

After being kept in a 1:1 HNO_3 solution in glass jars overnight, the samples were washed first in distilled, then in bidistilled water, and finally dried. In order to eliminate the organic compounds and release the inorganic compounds in a soluble phase, 1 g cheese samples were placed in Teflon containers, to which a combination of 5 ml of 65% nitric acid (Merck, 1.00452) and 5 ml of 30% hydrogen peroxide (Merck, 1.08597) was added. The Teflon containers were capped and the samples were ashed in a Mars-5 microwave oven (Cem Corporation) using a two-stage procedure. First, the samples were washed in bidistilled water and complemented to 50 ml with bidistilled water. In the second stage, the samples were filtered using S&S blue tape filter papers. A blank solution was prepared in the same way. In order to avoid metal contamination, materials used in the dissolution of the samples were rinsed a couple of times with 1+9 (v/v) HNO_3 ultra-distilled water. Then, the materials were thoroughly washed and rinsed with ultra-distilled water and dried in the stove. The levels of mineral substances and heavy metals in the samples were measured using the ICP-OES (Thermo scientific ICAP 7400) device (14).

Statistical Analysis

The results obtained from the cheese samples were analyzed using the SPSS package program (version 18) to determine the minimum, maximum, average values and standard deviations (15).

RESULTS AND DISCUSSION

The mineral analyses of our study are given in Table 1.

As seen from Table 1, in Cami Boğazı cheese samples, of the calcium and sodium contents, calcium values are found lower than Yüzbaşı and Demirözü (16) have determined in the studies they have conducted in Ankara (7067.00±3069 and 4334.0±3021mg/kg)) while sodium values are found higher, and also higher than the values determined in the studies of Öksüztepe et al. (17) in Elazığ (327.76±36.7 µg/kg and 620.40±68.12 µg/kg) and Kılıç et al. (18) in Izmir (797.962±200.28 mg/100g and 1212.32±370.66 mg/100 g). Potassium content was recorded rather lower than the findings obtained by Öksüztepe et al. (17) as 1142±512.50mg/kg, and Yüzbaşı and Demirözü (16) as 1742.00±602 mg/kg. While average magnesium content of Cami Boğazı cheeses is determined quite lower than the value determined by Yüzbaşı and Demirözü (16) as 6026.00±908 mg/kg, it was higher than the value determined by Işleten et al. (19) as 27.42 ±60.51 mg/100g. Phosphor content of cheese samples is recorded considerably higher than the findings Kılıç et al. (18) and Öksüztepe et al. (17) have obtained as 448.09±100.27 mg/100 and 67.46±5.83 mg/kg, respectively.

As a result of loss in moisture in cheese with maturation, a proportional increase specifically in sodium amount is possible (20). These differences in mineral substance level in Cami Boğazı cheeses may be subject to the soil structure where the animals are raised, seasonal changes, content of the milk being used and different cheese

Table 1. Mineral substance content in the Cami Boğazı cheese samples (mg/kg) n= 15

Mineral Substances	Mean *	Min.	Max.
Ca	3573.4±249.61	2212.5	5320
K	452.13±25.305	280.10	571
Mg	164.23±8.97	111.20	214
Na	8413.30±506.59	4852.5	10520
P	4272±269.90	2412.5	5485

* Mean ± Standard Error

production techniques. Thus various researchers have emphasized that cheese production techniques and environmental conditions may result in variations in the mineral substance contents of the cheeses produced (7).

The obtained heavy metal results of our study and their suitability with Turkish food Codex are taking place in Table 2.

As clearly seen from Table 2, iron content in Cami Boğazı cheeses is found lower than the values determined by Yüzbaşı and Demirözü (16) as 3.05±1.27 mg/kg and by Temurci and Güner (21) as 62.56±3.5 mg/kg, and zinc content is found lower than the values Yüzbaşı and Demirözü (16) have obtained as 4334.00±3021mg/kg in a study they've conducted in Ankara. Milk and dairy products are not the main sources for iron. Iron content in these products is arising from using iron containing materials during pasteurization processes applied on milk and process of deriving products from milk (22). Besides, average zinc content in Cami Boğazı cheeses is found higher than the values Yalçın and Tekinşen (23) have determined in Konya as 15.96±1.30 mg/kg and Işleten et al. (19) have determined as 2.12±8.19 mg/100g. Variations detected in zinc content of cheeses in different researches are thought to be arising from milk used in cheese production and tools and equipment used at production stage. This situation is also expressed by Yalçın and Tekinşen (23). Besides, it is reported that 85% of zinc in milk is subject to casein micelles and is separated from curd by becoming free in acidic pH values (7, 20). Average contents of mineral substances and heavy metals in the composition of milk are stated as calcium 1221-1259 mg/L, potassium 1424-1550 mg/L, sodium 310-523 mg/L, magnesium 89-228 mg/L, iron 0.70-2.40 mg/L, zinc 0.96-4.84 mg/L, copper 0.19-0.29 mg/L, manganese 0.02-0.038 mg/L, nickel 0-0.730 µg/L, lead 4-100 µg/L and arsenic 30-100 µg/L (2, 24). As mineral substances, heavy metals are also transferred to milk in a specific ratio. For this reason, heavy metal level in Cami Boğazı cheese may change according to the heavy metal contamination of milk used in cheese production. In the "Communiqué on Determining Maximum Limits of Contaminants in Food Products" of Turkish Food Codex (25, 26), acceptable values of heavy metals in some foods are determined although they are not the maximum limits of Cami Boğazı cheese. However, heavy metal quantities detected in the samples are stated to be within the limits Turkish Food Codex (25, 26) has determined in some foods (Table 2).

In conclusion, the results of the study are favorable in terms of demonstrating that the heavy metal content of Cami Boğazı cheese is within acceptable limits. However, since high levels of heavy metals can lead to serious health hazards, it is crucial to ensure sustainability in healthy and safe cheese production. To this end, cheese production techniques should be standardized; the tools and equipment used in production and storage should be in line with the required standards; and production facilities and materials used in production should be located far from chemical wastes and environmental pollution. Furthermore it is recommended that chemical feed should not be used in animal feed preparations where there is a risk of environmental contamination and livestock feed should be prepared in isolation from chemical nutrients.

Table 2. Heavy metal content in the Cami Boğazı cheese samples (mg/kg) n= 15

	Heavy metal (mg/kg)					
	Fe	Cu	Pb	Cd	Zn	Mn
Mean	0.371±0.177	1.350±0.108	0.179±0.036	0.028±0001	27.52±1.85	0.313±0.11
Min	-	0.90	-	0.02	11.88	-
Max	0.90	2.04	0.38	0.035	36.94	0.33
**Maximum Limit mg/kg	0.2-25	0.05-25	0.02-2	0.05-1	5-50	-
Status	Normal	Normal	Normal	Normal	Normal	-

* Mean ± Standard Error

** Turkish Food Codex Maximum Limits of Contaminants in Food (25, 26)

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