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# The Microbiological Quality of Çiğ Köfte Sold in Ankara

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**Abstract:** Çiğ köfte is a special Turkish meal prepared from minced meat, bulgur, onions, garlic and different spices. In this study, a total of 50 çiğ köfte samples sold in Ankara were microbiologically analysed in order to determine their microbiological quality. The numbers of total mesophilic aerobic bacteria, lactobacilli, micrococci/staphylococci, coagulase-positive staphylococci, enterobacteriaceae, coliform, enterococci, pseudomonas, yeasts and molds were determined by drop plating, whereas the *B. cereus* count was determined by spread plating, and the isolation of Salmonella involved enrichment procedures.

The mean numbers of total mesophilic aerobic bacteria, lactobacilli, and micrococci/staphylococci were  $10^6$  cfu/g,  $10^5$  cfu/g,  $10^4$  cfu/g, respectively. The mean number of coagulase-positive staphylococci was  $10^2$ -  $10^3$  cfu/g in 18% of the samples analysed, and 82% of the samples were determined to be under the detection limit. The mean number of index microorganisms, including enterobacteriaceae, coliform and enterococci, was  $10^4$  cfu/g. The levels of pseudomonas, yeasts and molds were  $10^3$  and  $10^4$  cfu/g, respectively. The numbers of *B. cereus*, an important food intoxication agent, was  $10^2$ -  $10^4$  cfu/g in 46% of the samples. Salmonella was not isolated from any of the samples analysed.

We concluded that the çiğ köfte samples analysed were of very poor microbiological quality and could pose a risk to public health.

**Key Words:** Çiğ köfte, microbiological quality, food hygiene.

## Ankara'da Tüketime Sunulan Çiğ Köftelerin Mikrobiyolojik Kalitesi

**Özet:** Çiğ köfte, kıyma, bulgur, soğan, sarımsak ve çeşitli baharatın karışımından oluşan Türkiye'ye özgü geleneksel et ürünüdür. Bu çalışmada, Ankara'da farklı semtlerden alınan toplam 50 adet çiğ köfte örneği mikrobiyolojik kaliteleri yönünden analiz edilmiştir. Bu çerçevede, çiğ köfte örneklerinde, toplam aerob mezofil bakteri, laktobasil, mikrokok/stafilokok, koagülaz pozitif stafilokok, enterobakteri, koliform, enterokok, pseudomonas ve maya/küf damla plak, *B. cereus* yayma plak tekniği ile, Salmonella varlığı ise zenginleştirme yöntemi ile belirlenmiştir.

Analiz bulguları çerçevesinde, toplam aerob mezofil bakteri sayısı ortalama  $10^6$  kob/g, laktobasiller ise ortalama  $10^5$  kob/g olarak bulunmuştur. Örneklerden ortalama  $10^4$  kob/g düzeyinde mikrokok/stafilokok izole edilmiş, koagülaz pozitif stafilokokların örneklerin % 18'inde  $10^2$  -  $10^3$  kob/g arasında değişen düzeylerde olduğu, % 82'sinde ise kullanılan metodun saptama sınırının altında kaldığı belirlenmiştir. Hijyen indeksi mikroorganizma olan enterobakteriler, koliform bakteriler ve enterokoklar ortalama  $10^4$  kob/g düzeyinde bulunmuştur. Pseudomonaslar ortalama  $10^3$  kob/g, maya ve küfler ise ortalama  $10^4$  kob/g düzeyinde izole edilmiştir. Önemli gıda patojenlerinden olan *B. cereus* sayısı örneklerin % 46'sında  $10^2$  -  $10^4$  kob/g değerinde bulunmuştur. İncelenen çiğ köfte örneklerinin 25 gramında Salmonella varlığına rastlanmamıştır.

Sonuç olarak, bu çalışmada incelenen çiğ köfte örneklerinin mikrobiyolojik kalitelerinin düşük olduğu ve halk sağlığı yönünden risk oluşturabilecekleri saptanmıştır.

**Anahtar Sözcükler:** Çiğ köfte, mikrobiyolojik kalite, gıda hijyeni

## Introduction

Çiğ köfte is a product made with raw meat that is produced in Turkey, especially in South-east Anatolia. It is prepared by adding various ingredients such as spices, onions, tomato paste and parsley into fat-free minced meat and bulgur, mixing the ingredients by hand and then

molding their final form. Since çiğ köfte is consumed raw it may present an increased health risk (1,2).

Although çiğ köfte is commonly consumed in Turkey, there is no specific standard regarding the level of microbiological quality, ingredients or manufacturing technique. The microbiological quality of çiğ köfte

depends on the hygienic quality of its ingredients. High levels of microorganisms, including pathogens, have a negative effect on the hygienic quality of çiğ köfte. Due to the nature of its preparation, personnel hygiene is very important for çiğ köfte quality. Poor personnel hygiene during production probably leads to the contamination of çiğ köfte with pathogenic microorganisms, especially coagulase positive staphylococci (1,3). In addition, çiğ köfte, which is generally consumed immediately after production, is kept at room temperature in hypermarkets and restaurants. As a result of using raw materials of poor microbiological quality, inadequate personnel hygiene and a long period between production and consumption at room temperature, çiğ köfte poses a potential risk to public health. There are only a few studies about the microbiological quality of çiğ köfte in Turkey. This study aimed to determine the hygienic quality of çiğ köfte consumed in Ankara.

### Materials and Methods

In this study, a total of 50 çiğ köfte samples sold in different regions of Ankara at various times were used. At least 200 g of çiğ köfte from each sample were taken aseptically and brought to the laboratory under cold chain and examined immediately on arrival.

In order to determine the microbiological quality of çiğ köfte samples, except for Salmonella, a 10 g çiğ köfte was taken from each sample and added to 90 ml of 0.1% sterile peptone water and then homogenized in a stomacher (Lab. Lemco 400) for 2 min. Decimal dilutions were carried out up to  $10^{-7}$  using 0.1% peptone water. The number of total mesophilic aerobic bacteria, lactobacilli, micrococci/staphylococci, enterobacteriaceae, coliform, enterococci, pseudomonas, yeasts and molds was determined by drop plating, whereas the *B. cereus* count was determined by the spread plating technique. Coagulase-positive staphylococci was determined by the coagulase test in a tube with coagulase plasma EDTA (DIFCO 0803-46-5) applied to 5 typical and non-typical staphylococci colonies grown in Baird-Parker medium. The colonies which grew in CFC agar and were oxidase test positive were determined to be pseudomonas (Oxidase paper, Merck 13300). The detection of Salmonella in çiğ köfte samples was carried out by enrichment procedures in 2 steps using 25 g samples according to published methods (4,5).

The media and incubation conditions used in this study are given in Table 1.

### Results

The results of microbiological analyses obtained from 50 çiğ köfte samples sold in Ankara are given in Tables 2 and 3. According to our findings, the mean numbers of total mesophilic aerobic bacteria were  $10^6$  cfu/g in 54% of çiğ köfte samples,  $10^7$  cfu/g in 26%,  $10^5$  cfu/g in 12%, and  $10^8$  cfu/g in 8% of the samples analysed. The number of lactobacilli showed a similar trend but was 1 log less. The level of micrococci/staphylococci was  $10^4$  cfu/g in all samples. The number of the coagulase-positive staphylococci was around  $10^2$ – $10^3$  cfu/g in 18% of the samples and the counts for the remaining 82% of the samples were under the detection limit of the method used in this study. The mean numbers of enterobacteriaceae, coliform and enterococci were found to be  $10^4$  cfu/g in all the samples examined. The level of pseudomonas was  $10^3$  cfu/g and yeast and molds were  $10^4$  cfu/g. The number of *B. cereus* was  $10^2$  cfu/g in 34% of the samples,  $10^3$  cfu/g in 8%, and  $10^4$  cfu/g in 4%, whereas it was under the limit of detection ( $<1.0 \times 10^2$  cfu/g) in 54% of the samples analysed. Salmonella was not isolated from any of the samples examined.

### Discussion

In this study, we found that the microbiological quality of çiğ köfte samples purchased from hypermarkets and restaurants in Ankara was very poor. The mean number of total mesophilic aerobic bacteria was  $10^6$  cfu/g, which was in agreement with the work of Arslan et al. (6). Göktaş and Tunçel (7) found that the level of total mesophilic aerobic bacteria in minced meat used for producing çiğ köfte was  $10^5$  cfu/g, and this level was constant after production. However, Erol et al. (8) detected that the number of total mesophilic aerobic bacteria of minced meat used for producing çiğ köfte was  $10^5$  cfu/g, but increased up to  $10^7$  cfu/g within 24 h of production. In another study conducted to determine the bacteriological quality of minced meat sold in Ankara (9), the average level of total mesophilic aerobic bacteria was  $10^7$  cfu/g. In a study related to spices (10), the contamination levels of total mesophilic aerobic bacteria were  $10^6$  cfu/g in black pepper and red pepper powder,  $10^5$  cfu/g in red pepper, and  $10^4$  cfu/g in cumin.

Table 1. Media, incubation conditions for the enumeration of microorganisms in the çiğ köfte samples.

Type of Microorganisms	Growth medium	Incubation Conditions		
		Temp. (°C)	Time	Anaerobic/Aerobic
Total Mesophilic Aerobic Bacteria	Plate Count Agar (DIFCO 0479-17-3)	30	48-72 h	Aerobic
Lactobacilli	Lactobacilli Agar AOAC (DIFCO 0900-15-4)	30	24-48 h	Anaerobic
Micrococci and Staphylococci	Baird-Parker Agar (MERCK 5406) Egg-Yolk Tellurite Emulsion (MERCK 3785)	37	24-48 h	Aerobic
Enterobacteriaceae	Violet Red Bile Lactose Glucose Agar (OXOID CM 485)	37	24-48 h	Anaerobic
Coliform Bacteria	Violet Red Bile Lactose Agar (OXOID CM 107)	37	24-48 h	Anaerobic
Enterococci	Slanetz-Bartley Medium (OXOID CM 377)	37	24-48 h	Aerobic
Pseudomonas	Pseudomonas Agar Base (CFC Agar) (OXOID CM 559) CFC Selective Agar Suppl. (OXOID CM 377)	30	48 h	Aerobic
<i>Bacillus cereus</i>	<i>Bacillus cereus</i> Selective Agar (OXOID CM 617) Selective Suppl. (SR 99)	30	48 h	Aerobic
Yeast/Mold	Rose Bengal Chloramphenicol Agar (OXOID CM 549) Chloramphenicol Selective Suppl. (OXOID SR78)	25	4-5 h	Aerobic
Salmonella	TPS (DIFCO 1810-17-9)	37	24 h	Aerobic
	Rappaport-Vassiliadis Enrichment Broth (OXOID CM 669)	43	24-48 h	Aerobic
	Brilliant Green Phenol Red Lactose Sucrose Agar (MERCK 7237)	37	24-48 h	Aerobic

Table 2. The logarithmic number of microorganisms determined in çiğ köfte samples ( $\log_{10}$  cfu/g).

Sample	Parameter	TMAB	Lactobacilli	Mic/Staph	Coag. (+)	Ent.	Clf.	Enc.	Ps.	<i>B. cereus</i>	Yeast/Mold
Çiğ köfte	X	6.06	5.24	4.92	2.94	4.39	4.24	4.25	3.39	2.75	4.65
	Sx	0.17	0.11	0.13	0.14	0.0031	0.0088	0.11	0.14	0.15	0.10
	Min.	5.40	4.78	3.60	2.30	3.30	2.78	2.60	2.30	2.00	2.60
n: 50	Max.	8.83	7.20	6.95	3.60	6.20	5.71	6.11	5.11	4.41	6.76

Table 3. Distribution of microorganisms isolated from çiğ köfte samples.

Sample	Level of m.o. (cfu/g)	TMAB n %	Lactobacilli n %	Mic/Staph n %	Coag.(+) n %	Ent. n %	Clf. n %	Enc. n %	Ps. n %	<i>B.cereus</i> * n %	Yeast/Mold n %
Çiğ köfte n: 50	< 2.0 x 10 <sup>2</sup>	-	-	-	41 (82)	-	-	-	12 (24)	27 (54)	-
	10 <sup>2</sup>	-	-	-	3 (6)	-	1 (2)	1 (2)	15 (30)	17 (34)	3 (6)
	10 <sup>3</sup>	-	-	9 (18)	6 (12)	14 (28)	15 (30)	20 (40)	11 (22)	4 (8)	4 (8)
	10 <sup>4</sup>	-	7 (14)	17 (34)	-	29 (58)	28 (56)	18 (36)	8 (16)	2 (4)	26 (52)
	10 <sup>5</sup>	6 (12)	21 (42)	15 (30)	-	04 (8)	6 (12)	10 (20)	4 (8)	-	16 (32)
	10 <sup>6</sup>	27 (54)	12 (24)	9 (18)	-	3 (6)	-	1 (2)	-	-	1 (2)
	10 <sup>7</sup>	13 (26)	10 (20)	-	-	-	-	-	-	-	-
	10 <sup>8</sup>	4 (8)	-	-	-	-	-	-	-	-	-

\* The detection limit 1.0 x 10<sup>2</sup> cfu/g

TMAB: Total mesophilic aerobic bacteria  
 Mic/Staph: Micrococci/Staphylococci  
 Coag.(+): Coagulase-positive staphylococci  
 Ent.: Enterobacteriaceae  
 Clf.: Coliform  
 Enc.: Enterococci  
 Ps: Pseudomonas

The mean number of lactobacilli isolated from samples was 10<sup>5</sup> cfu/g. Erol et al. (8) found that the level of lactobacilli was 10<sup>3</sup> cfu/g in minced meat used for manufacturing çiğ köfte and it increased to 10<sup>7</sup> cfu/g within 24 h of manufacturing. As total mesophilic aerobic bacteria levels increased, lactobacilli became the dominant flora in the çiğ köfte.

In this study, the mean level of micrococci/staphylococci was 10<sup>4</sup> cfu/g, while the level of coagulase-positive staphylococci, which is an important food pathogen, was 10<sup>2</sup>–10<sup>3</sup> cfu/g in 18% of samples and it was under the detection limit in the rest of the samples (82%). Arslan et al. (6) found a higher level of coagulase-positive staphylococci (10<sup>3</sup>–10<sup>5</sup> cfu/g) than of staphylococci (10<sup>5</sup> cfu/g). This difference may be due to the different techniques used. In addition, the microbiological quality of ingredients such as minced meat, spices and personnel hygiene could be different. Erol et al. (8) determined that *S. aureus*, inoculated into çiğ köfte at 10<sup>3</sup>-10<sup>5</sup> cfu/g, could not grow to levels which produce toxins under the competitive effect of flora. However, they suggested that minced meat, spices, and other çiğ köfte ingredients had to be of good hygienic quality and it was necessary to pay attention to personnel hygiene during manufacturing. This conclusion was confirmed by Göktan and Tunçel, (7) who showed that 1.1 x 10<sup>2</sup> cfu/g *S. aureus* was detected in minced meat used in producing çiğ köfte.

In our study, we determined that the level of enterobacteriaceae was between 10<sup>3</sup> and 10<sup>6</sup> cfu/g, and

the mean level was 10<sup>4</sup> cfu/g. In an experimental study by Erol et al. (8), the counts of enterobacteriaceae of minced meat used for manufacturing çiğ köfte was 10<sup>4</sup> cfu/g and increased up to 10<sup>5</sup> cfu/g within 24 h of production. In a separate study conducted on spices by Erol et al. (10), enterobacteriaceae levels were 10<sup>2</sup>–10<sup>5</sup> cfu/g in black pepper, 10<sup>2</sup>–10<sup>4</sup> cfu/g in red pepper powder and 10<sup>2</sup> cfu/g in red pepper.

In this study, coliform counts were 10<sup>3</sup>–10<sup>4</sup> cfu/g in 86% of the samples, and 10<sup>5</sup> cfu/g in 12% of the samples analysed. Arslan et al. (6) reported that the coliform level in çiğ köfte samples was 10<sup>3</sup>–10<sup>5</sup> cfu/g. In another study, by Göktan and Tunçel (7), the level of coliforms in minced meat used for producing çiğ köfte was 10<sup>2</sup> cfu/g and in çiğ köfte prepared from the same minced meat was 0.9 x 10<sup>2</sup> MPN/g. Erol et al. (8) determined that the level of coliform bacteria in minced meat used for manufacturing çiğ köfte was 10<sup>3</sup> cfu/g and increased to 10<sup>5</sup> cfu/g within 24 h of manufacturing. In another study conducted on spices (10), it was found that the level of coliform bacteria was 10<sup>2</sup> cfu/g in 8% of cumin, 10<sup>3</sup> cfu/g in 88% of red pepper powder, and all the black pepper samples examined, while no coliform was detected in granular red pepper samples.

In our study, enterococci counts of çiğ köfte samples were between 10<sup>2</sup> and 10<sup>6</sup> cfu/g. Arslan et al. (6) determined that the level of enterococci was between 10<sup>3</sup> and 10<sup>5</sup> cfu/g. In an experimental study (8), the number of enterococci increased from 10<sup>2</sup> cfu/g to 10<sup>3</sup> cfu/g in çiğ köfte within 24 h of manufacturing.

In this study, *B. cereus* was determined to be  $10^2$  cfu/g in 34%,  $10^3$  cfu/g in 8%, and  $10^4$  cfu/g in 4% of the çiğ köfte samples analysed. As *B. cereus* is frequently isolated from spices, this aspect has an important impact on the microbiological quality of çiğ köfte. It was reported in various studies (8,11,12) that *B. cereus* was isolated from different spices at various levels ranging between  $10^2$  and  $10^5$  cfu/g.

In the present study Salmonella was not isolated from the çiğ köfte samples analysed. No study regarding the isolation of Salmonella from çiğ köfte was found in the literature. However, Erol (13), Poeta et al. (14) and Schmidt (15) determined the incidence of Salmonella in minced meat to be 3.3%, 5.3% and 5.45%, respectively. Tekinşen et al. (9) reported that Salmonella could not be isolated from minced meat.

The mean level of yeast and molds was  $10^4$  cfu/g. No study regarding the isolation of yeast and molds from çiğ köfte was found while there were various studies about

the isolation of yeast and molds from spices. Erol et al. (10) reported that the mean number of yeasts and molds of black pepper, red pepper powder, red pepper and cumin was  $10^3$  cfu/g. Tekinşen and Sarıgöl (16) determined that the yeast and mold count was  $10^3$ – $10^4$  cfu/g in similar spices examined by Erol et al. (10).

In conclusion, we determined that the hygienic quality of çiğ köfte was very poor. Factors such as poor handling, maintaining çiğ köfte at room temperature at points of sale and its consumption raw may cause food poisoning cases because the çiğ köfte might be contaminated with food pathogens including coagulase-positive staphylococci and *B. cereus*. Therefore, we suggest that using minced meat and spices of good hygienic quality, improving personnel hygiene, and cleaning, disinfecting and checking equipment used in manufacturing periodically are necessary to prevent food infection and intoxications which arise from the consumption of çiğ köfte.

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