

Microbial quality of ice cream sold openly by retail outlets in Turkey

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SUMMARY

This study aimed to investigate microbiological quality of ice cream samples sold openly (in small portions from bulk containers exposed to the open air) by retail markets in Turkey. The samples (n=73) were analyzed to determine the hygienic status of the ice creams and also for the presence of some Gram positive and Gram negative pathogenic bacteria. Hygienic parameters included the total aerobic mesophilic bacteria (TAB), *Enterobacteriaceae*, coliforms, *Enterococcus* spp., yeast and mould counts. The pathogens included *Staphylococcus aureus* (*S. aureus*), *Bacillus cereus* (*B. cereus*), *Escherichia coli* (*E. coli*), *E. coli* O157 : H7, *Salmonella* spp., *Yersinia* spp. Of the 73 ice creams examined, 4.1 % of the samples had unacceptable hygienic quality according to the criterion (10^5 cfu/g) recommended in Turkish Food Codex (TFC), 78 % of the samples contained the *Enterobacteriaceae* which had a higher detection rate than coliforms (52 %), ranging from 10^2 to 10^6 cfu/g. The numbers of coliforms were not in accordance with the standard of TFC (95 MPN cfu/ml). Considering the percentage distribution of *Enterococcus* spp. in samples, 47 % of the ice cream samples were within the range of 10^2 and 10^4 cfu/g. Total yeast and mould counts varied between 10^2 - 10^4 cfu/g and 18 % of samples would not be acceptable, based on TFC level. The counts regarding the yeast and mould ice cream samples suggest the need for adequate heat treatment and appropriate storage conditions. *E. coli* was found in 15 out of 73 ice cream samples, but interestingly there was no indication for the presence of *E. coli* O157 : H7. Out of 73 ice cream samples, 9.6 % gave positive result for *Yersinia* spp. Five (6.8 %) ice cream samples were found to be positive for the presence of *Salmonella* spp. while, 24 samples yielded positive for *S. aureus* which is in the range of 10^2 to 10^4 and 15 % of the samples do not comply with the TFC standards (10^2 cfu/g). *B. cereus* was present in 19 % of ice cream samples. The detection level for *B. cereus* (+) samples in this work cannot be regarded as potential hazard according to TFC (No : 24511) which is recommended to be lower than 1.0×10^4 cfu/g. This study has indicated that the hygienic quality of the investigated open ice creams samples were inadequate. Considering the *Enterobacteriaceae*, coliforms, *Enterococcus* spp., yeast and mould counts, and the presence of *S. aureus*, *E. coli*, *Salmonella* spp., ice creams sold in open may pose potential risk for public health especially for vulnerable people. This study supports the necessity of providing hygienic precautions by producers and retailers and their control periodically in Turkey.

KEY WORDS : Ice cream, Food Safety, Pathogens, Microbiological Quality, Public Health

RÉSUMÉ

Qualité microbiologique de glaces vendues en vrac dans les épiceries en Turquie

L'objectif visé par cette recherche est l'analyse de la qualité microbiologique d'échantillons de glaces vendues ouvertement (les glaces sont vendues en de petites portions dans des grands récipients exposés en plein air) par les épiceries en Turquie. Les 73 échantillons ont été analysés pour les bactéries pathogènes à Gram positif et à Gram négatif. Les paramètres hygiéniques recherchés ont été : la flore totale aérobie mésophile, les *Enterobacteriaceae*, les coliformes, les *Enterococcus* spp., le dénombrement des levures et moisissures. Les pathogènes recherchés sont les *Staphylococcus aureus* (*S. aureus*), les *Bacillus cereus* (*B. cereus*), les *Escherichia coli* O157 : H7, les *Salmonella* spp. et les *Yersinia* spp. Sur les 73 échantillons analysés, 4.1 % de ceux-ci ont dépassé les normes hygiéniques établies par le codex de l'alimentation turc (TFC). 78 % des échantillons contiennent des *Enterobacteriaceae*. Le pourcentage observé des coliformes ne correspond pas aux normes du Codex de l'Alimentation Turc (95 MPN cfu/ml). Lorsqu'on prend en considération le pourcentage de la dispersion de l'*Enterococcus* spp. dans les échantillons, 47 % des échantillons de glace avaient les valeurs comprises entre 10^2 et 10^4 cfu/g. Le dénombrement des levures et des moisissures était compris entre 10^2 et 10^4 cfu/g et, selon les normes du Codex de l'Alimentation Turc, 18 % des échantillons ne seraient pas acceptables. Nous avons noté la présence d'*E. coli* dans les 15 échantillons des 73 analysés mais il n'y avait aucun signe de la présence d'*E. coli* O157 : H7.

9.6 % des 73 échantillons ont donné un résultat positif pour *Yersinia* spp. Pour la présence de *Salmonella* spp, 5 échantillons (6,8 %) de glace ont donné un résultat positif. 24 échantillons ont donné un résultat positif pour la présence de *S. aureus* ; cette bactérie a été observée à des teneurs allant de 10^2 à 10^4 cfu/g et 15 % des échantillons n'étaient pas conformes aux normes (10^2 cfu/g) du Codex de l'Alimentation Turc (TFC). *B. Cereus* était présent dans 19 % des échantillons de glace mais a un niveau inférieur aux recommandations sanitaires. Cette recherche a démontré que les qualités hygiéniques des échantillons de glaces vendues ouvertement étaient insuffisantes. La présence d'*Enterobacteriaceae*, de coliformes, d'*Enterococcus* spp. et de certaines bactéries pathogènes peut représenter un risque potentiel pour la santé publique, surtout pour les enfants et pour les personnes sensibles. Ce travail montre la nécessité d'améliorer les pratiques hygiéniques chez les producteurs en Turquie et d'effectuer des contrôles réguliers.

MOTS CLÉS : glaces (crème glacée), sécurité alimentaire, bactéries pathogènes, qualité microbiologique, santé publique, hygiène.

Introduction

Ice cream is a popular product consumed particularly in summer as well as throughout all year and continues to be a dominant interest of large segments of the population [18]. The ingredients of ice cream may be various combinations of milk, cream, evaporated or condensed milk,

dried milk, coloring materials, flavors, fruits, nuts, sweetening agents, eggs and eggs products, and stabilizers. Any of these may contribute microorganisms and affect the quality of the product as judged by its bacterial load or its content of various specific species of bacteria [9,26]. Time-dependent heating during the ice cream making reduces largely the vegetative forms of the microorganisms. On the

other hand, spore bearing microorganisms may well pose risks through consumption of this kind of milk products. Furthermore, the presence of pathogens in ice cream samples is mostly by means of tools and equipments, water, workers, environment, packaging materials and contaminations during the transportation and distribution of ice cream [4,6,22].

The presence of pathogenic microorganisms in ice cream such as *Salmonella* spp. [5,8], *Staphylococcus aureus*, *Escherichia coli* [5,8,12,14,22,25] have been well documented, but examination of pathogenic bacteria like *Bacillus cereus*, *Yersinia enterocolitica*, *Listeria monocytogenes*, *Brucella* spp. and *E. coli* O157 : H7 have been rarely studied. These studies indicated the necessity for a more steady microbial examination of ice creams since ice cream is particularly consumed by children of vulnerable age groups [15,28]. Ice cream samples in this work were therefore examined in terms of microbial counts that allow the quantitative checking of principal hygienic parameters including the total aerobic counts, coliforms, *Enterobacteriaceae*, *Enterococci* spp. and yeast and mould. Additionally, examination of the pathogenic bacteria like *E. coli*, *E. coli* O157 : H7, *Yersinia* spp., *Salmonella* spp., *S. aureus*, *B. cereus*, were also performed.

Materials and methods

A total of 73 ice cream samples (100 g each) were collected and examined during July and August, 2004 in Kars, Turkey. The samples were transported to the laboratory in a cool box and stored at -20 C prior to examination. The preparation of the samples was carried out in according with the method of WARKE ET AL. [28]. Traditional microbiological methods and media were used for the isolation and enumeration of total aerobic mesophile bacteria, coliforms, *Enterobacteriaceae*, *Enterococci* spp., yeast-mould and the pathogenic bacteria like *E. coli*, *E. coli* O157 : H7, *Yersinia* spp., *Salmonella* spp., *S. aureus*, *B. cereus* (Table 1).

The number of *E. coli* was determined by the most probable number (MPN) technique with three tubes using Brilliant Green Bile 2 % Broth (Oxoid, CM31). The presence of *E. coli* in tubes was confirmed by streaking on Endo Agar (Oxoid, CM479). Colonies with characteristic greenish metallic color were confirmed as *E. coli* with the indole, methyl-red, Voges Proskauer, and citrate utilization (IMVIC) tests. For the identification of *S. aureus*, typical and atypical presumptive *Staphylococci* spp. colonies were examined by Gram stain, coagulase, catalase, and latex agglutination (Oxoid, FT0203) tests.

To identify *B. cereus*, presumptive pink-purple, opaque *B. cereus* colonies were subjected to confirmatory tests of Gram stain, catalase, motility, nitrate reduction, tyrosine decomposition, anaerobic fermentation of glucose, Voges Proskauer reaction and production of acid from mannitol and arabinose.

For *Salmonella*, typical *Salmonella* spp. colonies were subjected to the further biochemical and serological characterization tests using Triple Sugar Iron agar (TSIA) (Merck 103915) and Lysine Iron Agar (LIA) (Merck 111640), and agglutination (Oxoid FT 203) test.

For *E. coli* O157 : H7, colourless and sorbitol negative presumptive colonies were streaked on Fluorocult Violet Red Bile agar (Merck 1.04030) and incubated at 42 °C for 24-48 h. Then Gram stain, catalase, and IMVIC tests were performed to the isolates. Those confirmed with biochemical tests were then checked with Dryspot *E. coli* O157 latex agglutination (Oxoid, 200075) test. In parallel, isolates identified as *E. coli* O157 were also tested with antisera O157 and H7 (Oxoid, Denka Seikan 210753 and 211057) as described by the manufacturer.

For *Yersinia* spp., suspected colonies were subjected to Gram stain and further biochemical characterization tests of catalase, oxidase, urease, motility in SIM (Oxoid CM435) medium, growth on Kligler Iron Agar (KIA) (Oxoid, CM33).

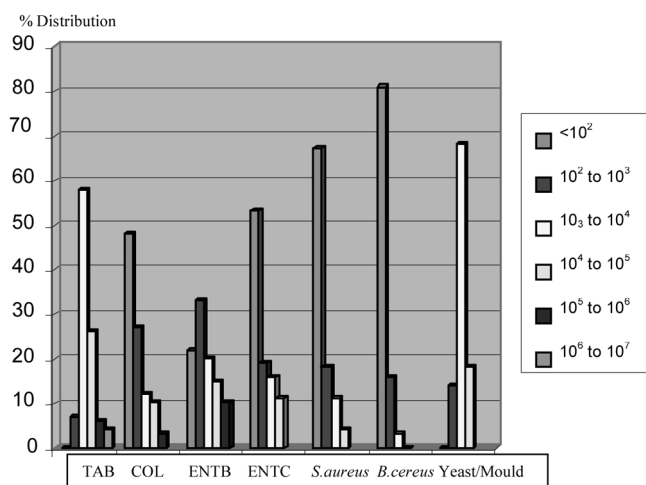
Results and Discussion

The results of this study are presented in Figure 1 and 2. The aerob mesophile bacteria (TAB) ranged between 10^2 - 10^6 cfu/g⁻¹. Ice cream is considered having unacceptable hygienic quality when the TAB exceeds 10^5 cfu/g⁻¹ according to the Turkish Food Codex (TFC) for ice cream (No : 24511) [2] (Table 2). Only 4.1 % of the samples in the current study exceeded this value. In previous studies, low levels of TAB were reported by SAGDIC ET AL. [22] and Kanbakan et al. [13] in the range of 2.1×10^1 - 2.6×10^4 cfu/g⁻¹ (Isparta, Turkey) and 1.7×10^4 - 1.7×10^5 cfu/g⁻¹ (Denizli, Turkey), respectively. On the contrary, unsatisfactory detection rate found for TAB in the present work was lower than the results reported as 33.3 %, 63.3 %, 44 %, and 49.27 % in the cities of Kars, Ankara, Aydn and Antalya of Turkey, respectively. [5,8,16,25]. Unsatisfactory levels of TAB have also been reported in many other countries. In the study of Masud [19] from Pakistan, 72 % of the samples had TAB counts over 10^6 cfu/g. From the city of Bangalore in India, Sarada and Begum [23] found 53 % of the samples had counts of $\geq 10^5$ cfu/g. MAIFRENI ET AL [17] from Udine in Italy reported that 8 % of the samples had TAB counts exceeding 10^5 cfu/g. WARKE ET AL. [28] from India also reported 33 % of the samples having excessive counts of 10^6 cfu/ml, which did not comply with the Indian standard. The results found in those studies and present work indicate that ice creams sold in small portions from bulk containers, exposed to the open air, have high microbial load, indicating low hygienic quality of the products in many countries. These high counts may originate from the initial microflora of raw milk and the other ingredients and their quality, the environment, insufficient heat treatment and poor personal hygiene. It has been previously stated that production of ice cream locally on a small scale rather than industrially is also a major factor associated with contamination of ice cream [4,8,13].

Seventy-eight percentage of the samples contained the *Enterobacteriaceae* which was a higher rate than faecal coliforms. Incidence of *Enterobacteriaceae* (53 %) in ice cream samples was also reported by EROL ET AL. [8]. *Enterobacteriaceae* in food products indicates faecal contamination. Therefore, microbiological quality of the samples in this study seems to be low. Poor microbiolog-

Bacteria	Media Used	Incubation Temperature (°C)	Incubation Time (days)
Aerob mesophile bacteria	Plate Count Agar (Oxoid, CM463)	30°C	2-3
<i>Enterococci</i> spp.	Kanamycine Aesculin Azide Agar (Oxoid, CM591)	37°C	1-2
<i>Enterobacteriaceae</i>	Violet Red Bile Glucose Agar (Oxoid CM485)	37°C	1-2
Coliforms	Violet Red Bile Lactose Agar (Oxoid CM107)	37°C	1-2
<i>Escherichia coli</i>	Brilliant Green Bile 2 % Broth (Oxoid, CM31)	37°C	1-2
	Endo Agar (Oxoid, CM479)	42°C	1-2
<i>Escherichia coli</i> O157 : H7	Modified Novobiocin EC Broth (mEC+n, Merck 1.10765)	42°C	1
	CT-SMAC (Oxoid CM 813 with SR 172 E)	42°C	1-2
	Flurocult Violet Red Bile (Merck 1.04030)	42°C	1-2
<i>Staphylococcus aureus</i>	Baird Parker Agar (Oxoid CM275)	37°C	1-2
<i>Bacillus cereus</i>	Cereus Selective Agar (Merck 1.05267)	30°C	1-2
<i>Salmonella</i> spp.	Buffered Peptone Water (Oxoid CM 509)	37°C	1
	Rappaport Vassiliadis Broth (Merck 1. 07700)	43°C	1
	Salmonella Shigella Agar (Merck 1.07667)	37°C	1-2
<i>Yersinia</i> spp.	Tryptone Soya Broth (Oxoid CM 129)	4°C	7,14,21
	Cefsuladin Irganan Novobiocin Agar (Oxoid CM653)	25°C	2
Yeast-mould	Rose Bengal Chloramphenicol Agar (Oxoid, CM 549)	25°C	4-5

TABLE 1. Traditional methods and media used for the isolation and enumeration of bacteria



TAB : Total aerob mesophile bacteria, COL : Coliforms, ENTB : *Enterobacteriaceae*, ENTC : *Enterococcus* spp.

*Turkish Food Codex requires maximum 1.0×10^5 cfu/ml for TAB, 95 MPN cfu/ml for COL, 1.0×10^4 cfu/ml for *B. cereus*, 1×10^2 cfu/ml for *S. aureus*, 1.0×10^2 cfu/ml for mould, 1.0×10^3 cfu/ml for yeast. It does not state any criteria for ENTB. and ENTC. (TCF No : 24511).

FIGURE 1. The percentage and viable count ranges of bacteria and the presence of some pathogens in ice cream samples sold openly*.

ical quality of the samples may be due to insufficient heat treatment, unhygienic handling of the ice creams before and during storage [11], and use of poor quality water since it has been revealed that poor quality of water used to wash the serving scoop can become significant source of contamination for the aerobic mesophilic bacteria, coliforms and *E. coli* [7,13,29].

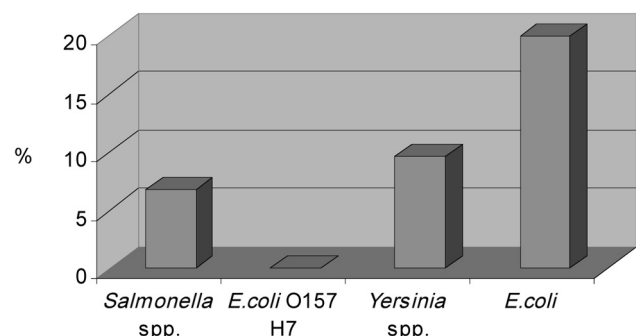


FIGURE 2. The percentage (%) of enteric pathogenic microorganisms in ice cream samples.

Coliforms were detected from 52 % of the samples in the range of 10^2 to 10^6 cfu/g and their numbers were not in accordance with the TFC standard of 95 MPN/ml (Table 2). Many reports dealing with the occurrence of coliforms in ice cream have been accumulated. In those studies, various rates of coliforms, which did not comply with the TFC standard in Turkey, were reported as 13.3 %, 40 %, 88.4 %, 96 % and 83 % by SAGDIC ET AL. [22], LELOGLU ET AL. [16], TOKLU AND YAYGIN [25], KANBAKAN ET AL. [13], and KIVANC ET AL. [14], respectively. Likewise, in some developing countries, such as Pakistan and India, several rates of coliforms were also reported as 66 % [19]. and 100 % [28], respectively. The presence of coliforms in ice cream samples may indicate insufficient heat treatment, unhygienic or low hygienic materials or tools used, water being contaminated or good manufacturing practice being not followed.

Microorganisms	Max. Numbers
Aerob mesophile bacteria (cfu/ml)	1.0×10^5
Coliform ^a	95
<i>E. coli</i> ^a	9
<i>Salmonella</i> spp.	Absent in 25 g
<i>L. monocytogenes</i>	Absent in 25 g
<i>Staphylococcus aureus</i> (cfu/ml)	1×10^2
<i>Bacillus cereus</i> (cfu/ml) ^b	1.0×10^4
Mould (cfu/ml)	1.0×10^2
Yeast (cfu/ml)	1.0×10^3

^a Based on MPN Table (/ml), ^b Applies to flavored ice cream.

*Modified from Turkish Food Codex Standards for plain and flavored ice cream (No : 24511).

Table 2. The Turkish Food Codex microbiological standards for ice cream *

E. coli is an indicator for faecal contamination and the possibility of the presence of enteric pathogens. *E. coli* was found in 15 out of 73 ice cream samples, The count of *E. coli* was found to be higher than 1.1×10^2 MPN/g in all positive samples and was higher than that of TAMSUT AND GARCIA [24] and Erol et al. [8]. However, there was no indication for the presence of *E. coli* O157 : H7 in our study. This may be due to low incidence of *E. coli* in milk and milk products. On the contrary, higher incidence rates than our result were also reported. MASUD [19] found that 46 % of the samples (n=50) were contaminated with *E. coli* and various incidence rates of 3.33 %, 22 %, and 70 % were also reported by EROL ET AL. [8], KIVANC ET AL. [14], and TOKLU & YAYGIN [25] in different cities of Turkey. Considering the *Enterobacteriaceae*, coliforms and the presence of *E. coli* in samples may indicate a lack of good manufacturing practice during the production and ice cream produced in domestic or catering premises may be relatively important vehicles for the causes of gastrointestinal diseases. These results, therefore, reveals a need for implementing regulatory measures like good manufacturing practices, hygienic distribution and retail storage practices for ensuring microbiological safety of ice cream sold in open containers. Likewise, personal hygiene should be emphasized as KANBAKAN ET AL. [12] stated that coliform contamination on the hands of personnel in sales department was higher than on the hands of factory workers and hand washing with soap only may not be enough for the cleaning of hands.

Of the 73 ice cream samples examined, 9.6 % gave positive result for *Yersinia* spp. The detection rate was extremely lower than the findings of WARKE ET AL. [28], who reported that 100 % of their samples were contaminated with *Yersinia* spp., but higher than the rate of 2.5 % reported by PEDERIVA AND GUZMAN [21]. Experimental studies have shown that the growth of *Yersinia* spp. are temperature-dependent and this is explained by the selective effect of refrigeration temperature which is more favorable for the growth of *Yersinia* spp. than other pathogens like *E. coli*, *S. Typhimurium*, *S. aureus* [1]. The low incidence of *Yersinia enterocolitica* in this study, in comparison with other patho-

gens, may presumably be due to the inefficient storage conditions which may favor the overgrowth of other microorganisms including pathogens. Transmission of this psychotropic bacterium via food chain has not been reported [28] but PEDERIVA AND GUZMAN [21] stated that ice cream may constitute a possible transmission path for *Y. enterocolitica*, and might lead to gastroenteritis outbreaks among children consuming great amounts of ice cream, particularly during the hot season. Therefore, contaminated ice cream samples may be a risky type of food for public health in terms of carrying the *Yersinia* spp.

As shown in Figure 2, five (6.8 %) samples were found to be positive for the presence of *Salmonella* spp. The detection rate for *Salmonella* spp. was not in agreement with the results of MAIFRENI ET AL. [17], KIVANC ET AL. [14], WARKE AL [28], ASLANTAS [3], and KANBAKAN ET AL. [13] who reported no *Salmonella* spp. in their ice cream samples. However, comparing to our results, lower frequency of *Salmonella* spp. contamination has been also reported in Venezuela and Camerun, ranging from 1 % to 5 % [24,30], respectively. Likewise, detection rate of *Salmonella* spp. in our study was significantly lower than the rate of 53 % reported by DIGRAK AND OZCELIK [5]. The presence of *Salmonella* spp. in ice cream may possibly be due to the either fresh eggs or egg powder used in the ice cream production as being stated in previous works. The presence of *Salmonella* spp. may pose a great risk for public health since *Salmonella* outbreaks from ice cream have been reported previously [10, 20,27].

Considering the percentage distribution of *Enterococcus* spp. counts in the samples, 47 % were within the range of 10^2 and 10^4 cfu/g, with the most being detected at 10^2 cfu/g. In previous works, the counts of $<1.0 \times 10^3$ cfu/g in some (89-94 %) ice cream samples were reported [17]. In a recent work, EROL ET AL. [8] found *Enterococcus* spp. counts ranging from 10^2 to 10^6 cfu/g, with the most being detected at 10^3 cfu/g in Ankara, Turkey. Their incidence frequency of 87 % for *Enterococcus* spp. were comparatively higher than our result. The count for *Enterococcus* spp. is being considered as one of the parameters used for food hygiene quality. Low hygienic quality of the samples regarding *Enterococcus* spp. occurrence in the previous and current work may have been resulted from insufficient heat treatment exposed to milk during the production or from post contamination.

In the present study, 24 samples yielded positive for *S. aureus* ranging from 10^2 to 10^4 cfu/g and 15 % of the samples do not comply with the TFC standard of 10^2 cfu/g. The absence of *S. aureus* in ice cream samples has been rarely reported in several studies [4,17,22,29]. On the other hand, lower or higher incidence rates of *S. aureus* than our result in this study have been reported. In Ankara and Elazig, Turkey, *S. aureus* was present in 10 % of the open ice cream samples at the counts of 10^3 cfu/g. In Aydin, Turkey, LELOGLU ET AL. [16] found this rate as 20 % at the counts above the safe limit level of 10^2 cfu/ml. Higher detection rates of 62.3 % and 100 %, at the counts above the safe limit level were also reported by KIVANC ET AL. [14] and WARKE ET AL. [28], respectively. The presence of *S. aureus* may be resulted from either insufficient pasteurization of milk, or human exposure. In humans, the main reservoir of *S. aureus* is the

nasal cavity. The organism finds their way to the skin and into wounds either directly or indirectly. The most common skin sources are arms, hands, and face. In addition to skin and nasal cavities, *S. aureus* may be found in the eyes, throat and intestinal tract. From these sources, the organism finds its way into air and dust, onto clothing, and in other places from which it may contaminate foods [11]. It is obvious from the previous and the present data that ice cream samples are frequently subjected to *Staphylococci* spp. contamination which may indicate inadequate personel hygiene of workers or sales people.

At present, there is no criterion for *B. cereus* in the TCF for plain ice cream as there is for flavored ice cream. *B. cereus* was detected in 19 % of the ice cream samples up to the counts of 10^4 cfu/g. This was lower than of a previous report of WARKE ET AL. [28] who found the incidence rate of 40 % for *B. cereus* in their samples. The detection level for *B. cereus* (+) samples in this work cannot be regarded as potential hazard according to the TFC standards, which is recommended to be maximum 1.0×10^4 cfu/g. Since *B. cereus* has been isolated in plain ice cream samples, it may be a good progress to cover *B. cereus* as well in the TFC for plain ice cream.

Total yeast and mould counts varied between 10^2 - 10^4 cfu/g. As indicated in Figure 1, 18 % of the samples were not satisfactory, based on the TFC standard. Likewise, unsatisfactory numbers were also reported in previous studies. Erol et al. [8] found a higher portion (56.6 %) of their samples being unsatisfactory. In another study, 60 % of the samples contained the yeast and mould between 10^4 and 10^5 cfu/ml. [28]. The counts of yeast and mould in the samples suggest the need for the control of adequate heat treatment of ice cream and appropriate storage conditions in catering premises.

In conclusion, the current investigation has indicated a poor overall level of hygiene in the service of openly sold ice cream in Kars, Turkey. The counts of microorganisms above the recommended criteria and the presence of some groups of pathogenic bacteria may pose a risk for public health particularly for children and vulnerable elderly people. It is clear from the previous and current studies that there is a necessity for developing the hygienic status of locally produced ice cream in domestic or catering premises in Turkey. Thus, good hygiene practises should improve the hygienic quality of ice cream especially in all steps, post-pasteurisation and at retail level. An increased level of staff training and transfer of knowledge, especially in relation to food safety, handling, maintaining and cleaning of machine and tools may improve the situation. Further improvements should be sought in personnel hygiene and the general hygiene conditions of premises. The mandatory adoption of a food safety management system based on the Hazard Analysis Critical Control Point (HACCP) should improve the quality of ice cream. The quality of the raw material prior to process, manufacturing and storage of the products under appropriate conditions should be given a priority and also in order to prevent the infections and toxifications resulting from pathogenic microorganisms, workers and sales people in both ice cream producing catering premises should be regularly checked for sustaining the favorable hygienic status

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