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Microbial Quality of Traditional Ice Cream Produced by Small-Scale Manufacturers in Khormoj and Its Comparison with the Iranian National Standard

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Abstract: Since, ice-cream harbors many potent pathogens, its microbial quality has always been crucially important in public health. In this study, 50 samples of ice cream produced by 25 different small-scale traditional ice cream manufacturers in Khormoj were studied for Total Bacterial Count (TBC), Enterobacteriacea count, coagulase positive Staphylococcal count, *E. coli* search and *Salmonella* sp. search, in order to determine if the samples meet the ice cream standard set by the Iranian National Standard Center. Out of total ice cream of Khormoj 44 samples (88%), 31 samples (62%) and 10 samples (20%) exceeded standard value of mesophilic aerobic count, Enterobacteriacea count and coagulase positive Staphylococcal count, respectively. Also, according to the results obtained from *E. coli* search, it was determined that 16% of ice cream samples examined were not fit bacteriologieally to the Iranian Ice Cream Standard. However, non of the samples were found to be contaminated with *Salmonella* sp. The microbial quality of grade 1 and 2 ice cream samples did not show significant differences. However, this study shows that the overall microbial quality of traditional ice cream samples being sold in Khormoj is poor.

Key words: Traditional ice cream, standard, Khormoj, total bacterial count, coliform, staphylococcus, *E. coli*, salmonella

INTRODUCTION

Ice cream is a frozen dairy food made by freezing a pasteurized mix. The mix is composed of a combination of milk products (milk, condensed milk, milk powder and cream), sugar, emulsifiers, stabilizers, flavouring and coloring agents. Ice cream is a palatable, nutritive and healthful food. Therefore, ice cream production has increased rapidly in recent years in many countries of the world (Kocak *et al*., 1998). In Iran, the production of ice cream is made in two different ways: traditional methods and the industrial production. The traditional production method refers to the manufactoring of open/artisanal ice cream. This kind of ice cream is generally manufactured in small scale production units which do not follow completely a standard procedure for production of ice cream. As, ice cream can become contaminated while adding some ingredients after pasteurization or by means of improper sanitation of the equipment and environment, many psychrotroph and psychrotolerant microorganisms like *Listeria monocytogens*, *Staphylococcus aureus*, *Bacillus*, *Salmonella*, *Shigella*, *Streptococus*, *Pseudomonas*, *Campylobacter*, *Brucella* sp. and coliform bacteria are generally present in this kind of product (Jay, 1992). Therefore, evaluation of the presence of microorganisms in these products can give us the information about the raw ingrediets quality and the sanitary nature of the processing and packaging stages. Therefor, there are lots of surveys on the bacteriological quality of ice crcam and related products (Massa *et al*., 1989). The present research was conducted to determine the sanitary quality of traditionally produced ice cream in khormoj (a city of Booshehr province) and comparing it to the Iranian Ice Cream National Standard.

MATERIALS AND METHODS

In this study, 50 samples of traditional ice cream collected randomly from 25 different local markets of Khormoj. The markets which had hygienic and acceptable appearance (according to the Iranian Institute of Food Control and Inspection) were nominated grade 1 and those which had poor appearance were called grade 2. The samples were collected in an ice box and immediately taken to the laboratory where they were kept at -20°C untill they were examined for the bacteriological quality.

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Ice cream samples were prepared according to the method described in the issue number 2450 of the Iranian Institute of standard and Industrial studies (Iranian Institute of Standard and Industrial Studies, 2001a). Bacteriological examination included the total bacteria, Enterobacteriacea and coagulase positive *Staphilicoccus aureus* counts, *E. coli* and *Salmonella* sp. search were also done according to the Iranian Institute of Standard and Industrial Studies (1991, 1994, 1995a, b and 2001b), respectively. SPSS software (Chi-square and Fishers exact test) were employed to statistically evaluate the data.

RESULTS AND DISCUSSION

Out of total 50 samples, 44 ice cream samples (88%) exceeded standard value of total mesophilic aerobic count which is 5×10^5 cfu g^{-1} (Iranian Institute of Standard and Industrial Studies, 2001a). In case of total Enterobacteriacea count, 31 samples (62%) crossed the standard value which is 100 cfu g^{-1}. Similarly, 10 samples (20%) and 8 samples (16%) were found crossing the standard value of Staphylococcal count (100 cfu g^{-1}) and *E. coli* (0 cfu g^{-1}), respectively.

However, none of the samples were found to be contaminated with *Salmonella* sp. The average counts for total mesophilic aerobic bacteria, Enterobacteriacea and coagulase positive *Staphylococcus aureus* were found to be 4.35×10^6, 1.6×10^4 and 1.9×10^3 cfu g^{-1}, respectively. In all the cases, the microbial quality of grade 2 ice cream samples did not show significant differences with grade 1 samples ($p>0.05$).

The bacteriological status of the samples are shown in Table 1 and the comparison of the bacteriological status of the samples (cfu g^{-1}) with the standard value is shown in Table 2. Ice cream is a fairly complex food containing sugar, emulsifiers and fats.

This investigation presents the current status of microbial quality of ice cream being sold in Khormoj. From the total analyzed ice cream samples (n = 50), 88% exceeded standard value of mesophilic aerobic count, 62% crossed the standard value of total Enterobacteriacea count, 20% were beyond the standard value of staphylococcal count and 16% were found to carry *E. coli* but none of the samples were found to be contaminated with *Salmonella* sp. These results are generally similar to the findings of other researchers and can be supported by the research of Massa *et al.* (1989) and Tamminga *et al.* (1980). Microbial quality of ice cream examined in Phillipines by Orallo *et al.* (1999) and Bangladesh by ME-Elahi *et al.* (2002) also showed the more or less comparable results.

Staphylococcus aureus is found to survive longer in ice cream (Gogov *et al.*, 1984). Staphylococci might enter the milk products from food handlers which either suffering from acute pyogenic infections or being healthy carriers harboring the organisms in nose or throat.

The presence of coagulase positive Staphylococcus which is mainly *S. aureus* can lead to the staphylococcal intoxication as a result of the growth and toxin production of this organism. The presence of starch and protein can also encourage the toxin production of these organisms (Jay, 1992).

The survival rate of the organisms depended both on the specific peculiarities of the individual strains and on the composition of the ice cream mixture. Exceeding the standard value in terms of mesophilic aerobic count may be because of poor handling of retailers. However, in terms of total coliform its cutting of standard value indicates the presence of fecal contamination of ice cream. This, suggests the possibility of the presence of other intestinal pathogens in this dessert. These microorganisms are transmitted via fecal-oral route.

Table 1: The bacteriological status of the traditional ice cream samples (cfu g^{-1})

		Total bacterial count		Enterobacteriacea count		Staphilococcal count	
Grade of samples	No. of samples	S.V.*	Average	S.V.*	Average	S.V.*	Averag
Grade 1	28	5.0×10^5	3.6×10^6	1.0×10^2	1.4×10^4	1.0×10^2	1.5×10^3
Grade 2	22		4.1×10^6		1.8×10^4		2.3×10^3

*S.V = Standard Value

Table 2: Comparison of the bacteriological status of the traditional ice cream samples (cfu g^{-1}) with the standard value

Grade of samples	TBC*	Enterobacteriacea	Staphilococcus	*E. coli*	Salmonella
Grade 1					
28 samples exceeded standard	24.0	17.0	4.0	5.0	0
Percentage of samples exceeded standard	89.2	60.7	14.3	17.8	0
Grade 2					
22 samples exceeded standard	19.0	14.0	6.0	3.0	0
Percentage of samples exceeded standard	86.4	63.6	27.3	13.6	0

*TBC = Total Bacterial Count

The study calls for actian in two fold: production permissions for artisanal ice cream manufacturing should be given only after a proper inspection against set standards. Periodical controls also should be conducted to control this kind of production. Consumers should be made aware of the non-hygienic quality of traditional ice cream and hygienic and other quality parameters of industrial ice cream.

CONCLUSION

The results show a negligence such as poor sanitation during the preparation or storage of ice cream including dirty premises using bare hands in preparing the products, etc. Even the raw milk could be a possible source of contamination. In the manufacturing processes, proper pasteurization is effective in destroying most of pathogenic bacteria. Automatic machines that are widely used for ice-cream production in dairy industry minimize direct hand manipulation and possibility of cross contamination. The present study shows the sub-standard microbiological quality of open/artisanal ice cream and encourage the consumers to shift to the packed/industrial ice cream with consistently good quality.

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