



Incidence of Coliforms in Ice Cream Sold in Cairo and Giza Markets

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Abstract

Ice cream is a highly nutritious dairy product commonly consumed all over the year, but especially in summer. It may harbor many potent pathogens. The microbial quality of ice cream, especially bacteriological quality, has always been crucially important to public health. In this study, the total coliform count in ice cream sold in Cairo and Giza markets was investigated. One hundred and twenty random samples of ice cream, representing 40 samples, each of: street vendors (small scale manufacturers), ice cream shops (moderate scale manufacturers) and supermarkets (large scale manufacturers) were collected, representing different flavored products with vanilla, chocolate, mango or strawberry. The results revealed the presence of coliforms in 100% of the examined samples of small scale, moderate scale and large scale, with mean values of $20 \times 10^3 \pm 6.6 \times 10^3$, 14.8 ± 3.6 and 18.7 ± 4.8 MPN/ml, respectively. The degree of acceptability of the examined samples as compared with Egyptian Standards was determined. Identification of the isolated 168 strains revealed presence of 9 different species of coliform at different percentages ranging from 0.5% to 45.8% of the isolates. The economic and public health significance of contamination of ice cream with coliforms was discussed, as well as the suggestive preventive and control measures to monitor production of high quality and safe product were suggested.

(Key words: ice cream, coliforms)

Introduction

Ice cream is a delicious nutritionally enriched congealed dairy product which has a high content of nutrients and has a therapeutic value for persons suffering from irritation and infection of the mouth and throat due to its coldness that consumed by all age groups particularly children. It is consumed all over the year especially in summer (Robinson, 1994; El-Sharef et al., 2006 and Ahmed et al., 2009).

Global production of ice cream has increased in recent years as it becomes 16.3 billion liters in 2010, up from 15.3 billion liters in 2006 (Goff and Hartel, 2013).

The possible sources of contamination are the used raw materials; the processing methods that are used in preparation, inappropriate holding temperature and poor personal hygiene (Barro et al., 2006 and Chukuezi, 2010).

The initial microflora of ice cream prior to pasteurization is largely determined by the individual ingredients, milk, cream, dried milk, etc., where flavorings and other ingredients; such as sugar, nuts, fruits and chocolate, are added, this is usually done after pasteurization. Therefore, there is a potential for such additions that introduce a wide range of other organisms not usually found in dairy products. In addition to the sources of contamination. The neutral pH of the product makes it an excellent growth medium for microbes. The microbial quality of ice cream

reflects the hygienic practice during production and is an indication of its safety. The microbial quality of ice cream is determined by total viable bacterial count, coliform count and the presence of pathogens (Ahmed et al., 2009).

Coliform bacteria belong to the larger group of gram-negative facultative anaerobic bacteria of the family Enterobacteriaceae, all of which are killed by pasteurization of ice cream mixes. The presence of coliform bacteria in ice cream is indicative of unsanitary practices (Marshall, 2001).

The coliform group includes species from the genera *Escherichia*, *Klebsiella*, *Enterobacter*, and *Citrobacter*, the existence of any of these types in dairy products is indicative of unsanitary conditions or practices during production, processing, storage or handling. One source of these organisms is the intestinal tract of warm-blooded animals, certain bacteria of non fecal origin is also members of this group (Greenberg and Hunt, 1985 and APHA, 2004).

Therefore, the aim of testing for coliforms is to measure the quality of the practices used to ensure proper processing and to minimize bacterial contamination of processed dairy products (APHA, 2004).

Materials and Methods

Collection of samples:

One hundred and twenty samples of ice cream, representing, 40 samples, each of: street vendors (small scale manufacturers), ice cream shops (moderate scale manufacturers) and supermarkets

(large scale manufacturers) were collected, under strict aseptic conditions, from Cairo and Giza markets. Collected samples were identified and kept in sterilized sampling jars & transferred to the laboratory in an insulated ice box supplemented with ice to be immediately examined.

Preparation of samples: (APHA, 2004)

Collected samples were thawed, under aseptic conditions, in a thermostatically controlled water bath at up to 40°C for not more than 15 minutes with continuous agitation.

Enumeration of coliform count (MPN/ml):

According to APHA, 2004

Identification of coliforms: According to Gleeson and Gray, 1997 and Silva et al., 2013

Result & Discussion

The result given in Table (1) & Fig. (1) reveal that coliforms could be detected in 100% of the examined samples of small, moderate and large scales, with a mean presumptive count of $20 \times 10^3 \pm 6.6 \times 10^3$, 14.8 ± 3.6 and 18.7 ± 4.8 MPN/ml, respectively.

Data presented in Table (2) show that the highest frequency distribution of coliform content in the examined samples of small scale were 11 samples (27.5%) lies within $10-10^2$, while for moderate and large scale 28 samples (70%) and 25 samples (62.5%) respectively, lies within <10 .

The obtained results of small scale ice cream are nearly similar to those reported by Warke et al. (2000) and Yaman et al. (2006); higher data were recorded by El-Bakery (2004); Anuranjini et al. (2008); Soliman (2008); Abdel-Fatah (2010) and Abo Zeed (2014), while lower results were obtained by Mohamed (2010); Osamwonyi et al. (2011); Ambily and Beena (2012); Jadhav and Raut (2014) and El-Ansary (2015).

The obtained results of moderate scale ice cream are nearly similar to those reported by Elahi et al. (2002); De farias et al. (2006) and Jadhav and Raut (2014); higher data were recorded by Warke et al. (2000); Said (2001) and Mohamed (2015), while lower results were obtained by El-Owni and Khater (2011); Movassagh et al. (2011) and Naim et al. (2014).

The obtained results of large scale ice cream are nearly similar to those reported by Ambily and Beena (2012) and Naim et al. (2014); higher results were reported by Baraheem et al. (2007); Abdel-Fatah (2010); Kumar et al. (2011); Hossain et al. (2012); Abo Zeed (2014); Mohamed (2010), while lower results obtained by El Owni and Khater (2011); Saad (2011) and Jadhav and Raut (2014).

On studying the degree of acceptability of the examined ice creams samples as compared with Egyptian standards for coliform count, 20%, 70% and 62.5% of the examined small scale, moderate scale and large scale samples, respectively, were acceptable (Table 3 & Fig. 2).

According to Egyptian Standards, total presumptive coliforms count (MPN/ml) should be not exceed 10 MPN/ml. So, higher coliform count clearly indicates inadequate handling practices at the selling point. Plant hygiene and personal hygiene should be suspected when coliform count of the product is high (Yadav et al., 1993). The scoop water can get contaminated by the unhygienic conditions during the sale, inadequate cleaning of the hands, bad practice as selling ice cream and collecting money by the same person. Open cones and unclean cloth for cleaning the scoops can contribute to high coliform count (Kanbakan et al., 2004). It is worth mentioning that when liquid medium (brilliant green lactose-bile broth) is used for isolation of coliforms, false-positives can be a problem at low dilutions due to the carry-over of sucrose, or other fermentable carbohydrate, from the ice cream (Varnam and Sutherland, 1994).

Escherichia coli failed to be detected in all the examined ice cream samples, concerning this point all examined samples were in agreement with basic requirements of Egyptian Standards.

Identification of isolated coliform organisms (168 isolates) from examined ice cream samples reveal the presence of: *Enterobacter amnigenus*, *Enterobacter intermedius*, *Klebsiella pneumoniae* subsp. *pneumoniae*, *Enterobacter cloacae*, *Serratia fonticola*, *Enterobacter aerogenes*, *Klebsiella pneumoniae* subsp. *ozaenae*, *Klebsiella oxytoca* and *Citrobacter diversus* in a percentage of 9.5, 19.6, 45.8, 5.9, 1.7, 20.2, 1.7, 0.5 and 0.5%, respectively (Table 4).

There are many public health and economic importance of the isolated coliform organisms as the genera *Klebsiella*, *Enterobacter*, *Serratia*, and *Citrobacter* (collectively called the coliform bacilli) responsible for a wide range of infections (Guentzel, 1996). Also it was reported by Sabota et al., 1998 a case of *K. pneumoniae* infection in Houston, Texas. The patient suffered from symptoms of gastroenteritis rapidly lead to multiorgan failure.

Also, *Enterobacter aerogenes* and *E. cloacae* several outbreaks of hospital-acquired infections in Europe and particularly in France (Pagès and Davin-Regli, 2015).

Table (1): Statistical analytical results of examined ice cream samples (40 sample each scale) based on their total coliforms count (MPN/ml).

Samples scale	Positive samples		Min.	Max.	Mean	S.E.M±
	No.	%				
Small scale	40	100	3	11×10^3	20×10^3	6.6×10^3
Moderate scale	40	100	0.3	93	14.8	3.6
Large scale	40	100	0.3	110	18.7	4.8

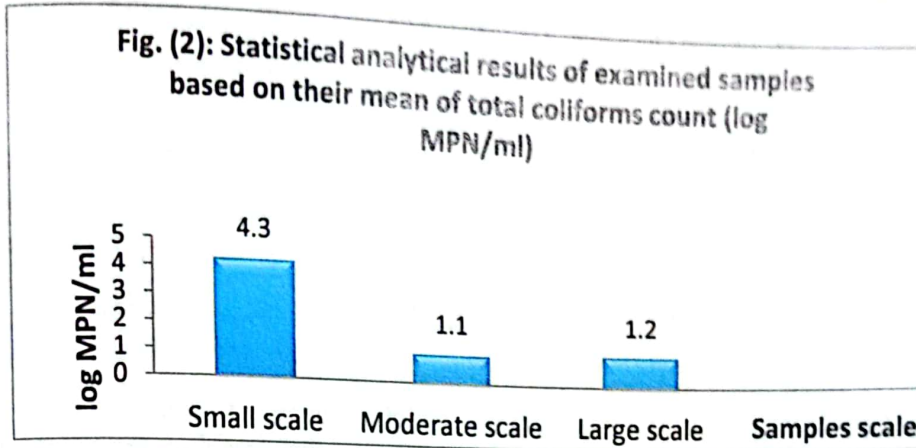


Table (2): Frequency distribution of examined ice cream samples based on their total coliforms count (MPN/ml).

Intervals	Small scale		Moderate scale		Large scale	
	No.	%	No.	%	No.	%
<10	8	20	28	70	25	62.5
10-10 ²	11	27.5	12	30	14	35
10 ² -10 ³	5	12.5	0	0	1	2.5
10 ³ -10 ⁴	9	22.5	0	0	0	0
10 ⁴ -10 ⁵	1	2.5	0	0	0	0
10 ⁵ -10 ⁶	7	17.5	0	0	0	0
Total	40	100	40	100	40	100

Table (3): Degree of acceptability of examined ice cream samples vs. Egyptian Standards (2005) 1185/01 for the presence of total coliforms.

Sample scale	Critical limit for total coliforms	Acceptable		Not acceptable	
		No.	%	No.	%
Small scale	<10 CFU/ml	8	20	32	80
Moderate scale	<10 CFU/ml	28	70	12	30
Large scale	<10 CFU/ml	25	62.5	15	37.5

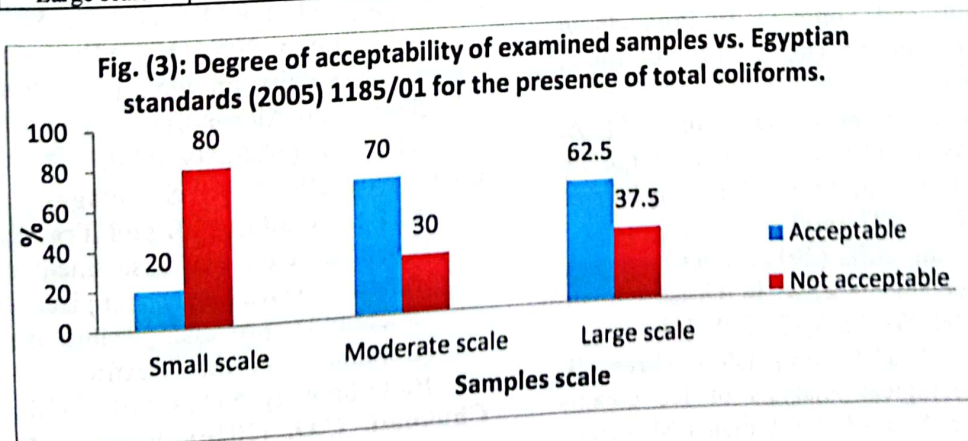


Table (4): Frequency distribution of isolated coliforms strains based on their identification (No. of isolates 168).

Isolated spp.	Small scale		Moderate scale		Large scale		Total	
	No.	%	No.	%	No.	%	No.	%
<i>Enterobacter amnigenus</i>	2	2.6	4	10	0	0	16	9.5
<i>Enterobacter intermedium</i>	18	23.6	6	15	9	17.3	33	19.6
<i>Klebsiella pneumoniae</i> <i>subsp. pneumoniae</i>	40	52.6	17	42.5	20	38.4	77	45.8
<i>Enterobacter cloacae</i>	2	2.6	4	10	4	7.6	10	5.9
<i>Serratia fonticola</i>	1	1.3	1	2.5	1	1.9	3	1.7
<i>Enterobacter aerogenes</i>	12	15.7	7	17.5	15	28.8	34	20.2
<i>Klebsiella pneumoniae</i> <i>subsp. ozaenae</i>	1	1.3	1	2.5	1	1.9	3	1.7
<i>Klebsiella oxytoca</i>	0	0	0	0	1	1.9	1	0.5
<i>Citrobacter diversus</i>	0	0	0	0	1	1.9	1	0.5
Total	76	100	40	100	52	100	168	100

Conclusion

To safeguard the consumer health and to save ice cream from being spoiled, all raw materials that are used in ice cream production must be of good quality; these materials should be obtained from trustworthy approved suppliers who is operating a quality program (HACCP plan), also the preventive measures have to be specifically targeted not only in production steps, but also in post-production period up to the consuming, especially at the selling points where there is a

high chance of contamination coliforms could survive the freezing temperature causing many health problems.

To improve quality of ice cream, Good manufacturing practice (GMP) is mandatory especially at all post pasteurization steps. Automatic machines to minimize handling will be effective in assuring quality. Adoption of good sanitation practices and application of the HACCP principles in the system along with training of workers on personal hygiene will definitely improve the quality of ice cream.

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الملخص العربي

مدي حدوث الميكروبات القولونية في الأيس كريم التي تباع في اسواق القاهرة والجيزة
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الأيس كريم من منتجات الألبان ذات القيمة الغذائية العالية يستهلك طوال العام خصوصا في فصل الصيف، وقد يحمل العديد من مسببات الأمراض القوية. الجودة الميكروبية للأيس كريم وخاصة البكتيرية لها تأثير هام علي الصحة العامة، في هذا البحث تم دراسة العدد الكلي للبكتريا القولون في الأيس كريم الذي تباع في أسواق القاهرة والجيزة. وقد تم تجميع مائة وعشرين عينة عشوائية من الأيس كريم، وهو ما يمثل 40 عينة، كل من: الباعة الجائلين (علي مستوي المنتج الصغير)، ومحلات الأيس كريم (علي مستوي المنتج المتوسط) ومحلات السوبر ماركت (علي مستوي المنتج الكبير)، تمثل المنتجات نكهات مختلفة الفانيليا، الشيكولاتة، المانجو و الفرولة. أظهرت النتائج وجود بكتيريا القولون في 100% من العينات التي تم فحصها على نطاق صغير، على نطاق متوسط وعلى نطاق واسع، مع متوسط قيم 4.8 ± 18.7 and 3.6 ± 14.8 , $10^3 \times 6.6 \pm 10^3 \times 20$ MPN / مل على التوالي. وقد تم عزل 168 سلالات منها 9 أنواع مختلفة من بكتريا القولون بنسب مختلفة تتراوح ما بين 0.5% إلى 45.8% من العزلات. وقد تم مناقشة الأهمية الاقتصادية والصحية لتلوث الأيس كريم بالبكتريا القولونية، و قد تم مناقشة الطرق الوقائية و طرق التحكم و ذلك لإنتاج منتج امن و عال الجودة.

