Original Research

Aerobic Plate Count of Milk and Dairy Products Marketed in Different Zones of Chennai

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Abstract

The present study was envisaged to ascertain the aerobic plate count of milk and dairy products as it may imply presence of potential pathogenic organisms which is a major concern in consumer's health point of view. A total of 567 samples, which comprises of 75 raw milk, 45 pasteurized milk and 447 dairy products were purchased from various retail outlets in different zones of Chennai. The results obtained were subjected to statistical analysis by using IDM®SPSS®Version 20.0 for windows®. Results of our study showed highest count from Chennai central zones. The microbial quality of raw milk and pasteurized milk samples tested from all the zones was found to be satisfactory. However, concentrated dairy products and khoa based dairy products tested were of unsatisfactory quality, and therefore, hygienic precautions should be taken by determining critical control points along with routine inspection of such dairy products during processing, storage, distribution and marketing.

Key words: Aerobic Plate Count, Microbial Analysis, Milk and Dairy Products

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Introduction

Milk is a wholesome food rich in nutrients commonly consumed all over the world. Pre-harvest and post-harvest contamination may attribute to microbial analysis. Microbial analysis of milk and dairy products is of important as it pose a public health threat if zoonotic disease causing microbes are present. In general, Aerobic Plate Count (APC) is used for monitoring the spoilage along with the microbial quality. APC

indicates the level of microorganism in milk and dairy products. Phillips *et al.*, 2013 suggested total plate count, coliform counts and generic *E. coli* counts as indicators of microbial quality. Total viable count serves as important criteria for evaluating the microbial quality of various foods and also degree of freshness of food Prejit *et al.* (2007). Van Den Berg (1988) also stated, total plate count as the most accurate method for counting live microorganisms in raw milk and heat treated milk. Aerobic plate count (APC) also known as total viable count (TVC) or standard plate count (SPC) can provide useful information to assess the quality of a food or its remaining shelf life. As this test does not indicate the presence of food-borne pathogens, unsatisfactory results do not directly relate to the safety of a food. Higher APC count indicates quality issues in milk and dairy products. It is recommended that, sampling by three-class attributes plans need to be undertaken for aerobic microorganisms, psychrotrophic microorganisms, lactic acid bacteria, yeasts, moulds (except for Mycotoxins), coliform, thermo tolerant coliforms (FSSAI, 2015). Accordingly, in the present study, 3 class sampling plan was followed to ascertain the aerobic plate count of milk and different dairy products.

According to FSSR (2016), the aerobic plate count/ml- for raw milk shall be less than 2, 00,000/ml and for pasteurized milk shall be less than 5 $x10^4$ /ml if it is termed to be satisfactory/acceptable quality. If the concentration of micro-organisms is above the value, it should be denoted as unsatisfactory/unacceptable quality. Similarly, the admissible limit for paneer, chhana and channa based sweets shall be $3.5x10^5$/g and in the case of khoa and khoa based sweets the limit shall be $7.5x10^4$/g. Furthermore, the allowable aerobic plate count for icecream shall be $2x10^5$/g. And, the admissible aerobic plate count for butter shall be $5x10^4$/g. Regarding sweetened condensed milk the admissible limit shall be $1x10^3$/g. No such limit has been prescribed for fermented milk products with regard to aerobic plate count. Aerobic plate count/ Standard plate count is an estimate of the total number of viable aerobic bacteria present in raw milk to assess the quality of a food or its remaining shelf life. In spite of its importance, the microbiological analysis of milk and dairy products has many limitations. Uncertainty of the analytical result must be considered when establishing microbiological criteria, including the variance associated with the sampling plan, method of analysis, and laboratory performance (Betts and Blackburn, 2009).

Materials and Methods

Sample Collection

The Chennai city has three regions viz. Chennai north, Chennai central and Chennai south and each region has five zones and thus the city is composed of fifteen zones. A total of 567 samples (75 raw milk, 45 pasteurized milk, 447 dairy products) were randomly collected from local milk vendors, cooperative milk dairies, dairy/ confectionery shops, supermarkets and sweet shops in sterilized milk collecting tubes and clean polyethylene bags aseptically at various locations of Chennai city and transported in insulated

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containers under refrigerated condition to the laboratory and stored at 4ºC and analyzed within 24 hr. The samples were collected during the period between September 2016 and November 2017. From each group, thirty representative samples were subjected to microbial quality testing by aerobic plate count method.

Preparation of Samples for the Determination of Microbial Quality

The procedure for determining APC by conventional plate count method in milk and dairy products was done following the standards of American Public Health Association (APHA) with slight modifications. All the samples were serially diluted by adding 1gm / ml into 9 ml of maximum recovery diluent, until a solution is expected to give a plate count between 25 and 250. One millilitre of the sample from a chosen dilution was placed on the petri dish with pour plated molten plate count agar (10 to 15 ml), allowed to solidify for 15 min and incubated for 48 hr at 37°C. Finally, the counts were made using digital colony counter. For enumeration plates showing colonies between 25 and 250 were selected Marshall (1992). The plate count was calculated by-

$$N = \sum C / [(1 \times n_1) + (0.1 \times n_2)] d$$

Where, N = number of colonies per milliliter or gram of product
$\sum C$ = sum of all colonies on all plates counted
n_1 = number of plates in lower dilution counted
n_2 = number of plates in next higher dilution counted and
d = dilution from which the first counts were obtained

The count was expressed as $\log_{10}$CFU/ml.

Use of Statistical Calculation for Processing of Data

Data on the total viable count/ml of milk sample were analyzed statistically using one way analysis of variance and correlation with the help of the IDM®SPSS®Version 20.0 for windows® to find out the level of significance and determine any significant correlation between the variable factors. The data presented in the Table 1 reflects the value of TVC per ml of milk sample collected from different areas zones of Chennai.

Results and Discussion

The APC for raw milk, pasteurized milk and the dairy products viz., heat and acid coagulated dairy products, concentrated dairy products, channa based dairy products, khoa based dairy products, fermented dairy products, frozen dairy products, chilled and flavoured dairy products and other dairy products like butter and cheese in Chennai north, Chennai central and Chennai south zones are detailed in Table 1. It is observed that, the APC for raw milk ranged from 2.8 to 2.9 $\log_{10}$ CFU/ml with the highest count from Chennai central zones. Similarly, the APC for pasteurized milk ranged from 2.26 to 2.61 $\log_{10}$ CFU/ml.

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Table 1: Aerobic plate count in milk and dairy products obtained from different zones of Chennai

Milk and Dairy Products (n=30)	Mean (log_{10}CFU/ml)			
	Chennai North	Chennai Central	Chennai South	F value
Raw milk	2.82 ± 0.01[a]	2.90 ± 0.00[c]	2.86 ± 0.01[b]	20.475**
Pasteurized milk	2.61 ± 0.02[c]	2.26 ± 0.11[a]	2.35 ± 0.18[b]	98.983**
Heat and acid coagulated dairy products	3.80 ± 0.18[b]	3.47 ± 0.17[a]	3.46 ± 0.00[a]	157.511**
Concentrated dairy products	5.63 ± 0.03[b]	5.46 ± 0.04[a]	5.62 ± 0.03[b]	8.353**
Channa based dairy products	4.28 ± 0.13[b]	3.43 ± 0.08[a]	4.49 ± 0.13[b]	22.773**
Khoa based dairy products	2.34 ± 0.28[a]	30.85 ± 0.09[a]	33.19 ± 0.25[a]	1.136NS
Fermented dairy products	29.56 ± 0.19[b]	30.90 ± 0.10[a]	30.455 ± 0.17[a]	28.217**
Frozen dairy products	3.95 ± 0.15[b]	11.64 ± 0.07[a]	15. 59 ± 0.01[a]	10.006**
Chilled and flavoured dairy products	1.42 ± 0.04[b]	4.468 ± 0.07[a]	5.89 ± 0.07[a]	9.393**
Other products (Butter and Cheese)	4.99 ± 0.20[a]	29.35 ± 0.09[b]	34.34 ± 0.15[a]	5.019**

*** Significant at 1% level (P < 0.01); NS Not significant (P > 0.05); Mean bearing different superscripts differ significantly; Mean bearing same superscripts in the same row do not differ significantly*

Between zones, in both raw and pasteurized milk, the counts were statistically significant. The aerobic plate count in all the milk-samples (both raw and pasteurized) milk was found to be less than the standards prescribed by FSSAI (2006) rules 2016. This shows that, strict hygienic practices would have been followed from the point of production to the point of delivery. It can be presumed that, the sampling area being parts of Chennai metropolis, the literacy rate and awareness on hygienic milk production practices could have contributed enormously to ensure acceptable/satisfactory quality milk. Further, it is to be noted that, pasteurization protocols were appropriate in processing plants of all the brands, as the aerobic plate count of all the pasteurized milk samples tested were within the limit prescribed. Similarly, the APC count for various dairy products like heat and acid coagulated, channa based dairy products, frozen dairy products, flavoured milks and other products (butter and cheese) tested from samples of all the zones were in compliance with the standards prescribed the FSSR (2016) for 3 class sampling plan and can be collectively denoted as satisfactory in quality. This also vouches the hygienic practices followed from the point of production, processing and till the delivery which is a good sign indeed in ensuring quality and safety in line with the mandate of Food Safety and Standards Authority of India.

On the other hand, concentrated dairy products and khoa based dairy products tested in this study were of unsatisfactory quality as the levels exceed the allowable limit of 1x103/g (sweetened condensed milk) and $7.5x10^4$/g respectively. Bhatnagar *et al.* (2007) screened khoa samples from Chambal region of Madhya Pradesh and reported total viable count ranged from 1.3 x 10^4 to 2.1 x 10^6 CFU/gm. Karthikeyan and Dhanalakshmi (2010) investigated khoa based milk sweets collected in and around Chennai from three different sources namely local vendors, private manufacturers and organized dairies and observed a total viable count ranging from $2x10^5$-$8x10^5$ cfu/gm,$1.9x10^3$-$2.3x10^5$ cfu/gm and $8x10^2$ to $3.1x10^4$ cfu/gm respectively. Further, Karthikeyan and Pandiyan (2013) analysed indigenous milk sweets such as khoa,

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burfi, gulabjamun, kalakhand and peda marketed in Tamil Nadu and reported a total viable count ranging from 10^3 to10^5 CFU/gm.

The results of the present study concurred with the results of various authors as mentioned above, who have also reported similar counts in dairy products. The higher aerobic count in dairy products is an indication of cross contamination which could have occurred during various stages of processing. An increase in microbial risk level of the dairy products may also attributed to the use of unpasteurized milk in the preparation of products and application of unhygienic traditional practices during processing and storage. It is observed that, among various categories of dairy products tested, the fermented dairy products showed higher APC count by khoa based dairy products. As there are no specific standards prescribed with regard to aerobic count at present, the results could not be compared and interpreted. It is to be noted that, the higher count in fermented milk includes good bugs also.

It is also observed that, among the three zones, higher APC count was noticed in dairy products of Chennai south zone followed by Chennai central and Chennai north. The possible reason for Chennai south zone showing higher counts in comparison with the other two zones might be due to coastal area with increased humidity, water activity and air current movements which would have facilitated favourable environment for the survival of the microorganisms. Further, the main reason for the variation in microbial load in milk and dairy products marketed in Chennai city may be attributed by change in environmental conditions such as temperature, pH, water activity, salt concentration etc.

Conclusion

The present study reveals that the microbial quality of raw milk and pasteurized milk samples was satisfactory. Further, dairy products like heat and acid coagulated, channa based dairy products, frozen dairy products, flavoured milks and other products (butter and cheese) tested from samples of all the zones were also found to be satisfactory. However, concentrated dairy products and khoa based dairy products tested in this study were of unsatisfactory quality, which may pose a potential public health risk and therefore, hygienic precautions should be taken by determining critical control point along with routine inspection of such dairy products during processing, storage, distribution and marketing.

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