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Studies on Microbiological Quality of Paneer Sold in various Zones of Maharashtra

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ABSTRACT: India is a rapidly growing dairy product market, where in paneer market is growing at the rate of 8% with annual consumption of over 20,000 tons of paneer. Paneer has moisture content of 40-60%, protein biological value of 80-86 and protein content of 15-20%, and fat of 16-20% with rich source of minerals like calcium. Under refrigeration condition paneer has a shelf life of 2-3 days thereafter freshness of the product is lost. Therefore, the present investigation was planned and executed to ascertain the microbiological quality of Paneer sold in four zones of Maharashtra, *viz.*, Marathwada, Vidarbha, Western Maharashtra and North Maharashtra. Fifteen *Paneer* samples were procured in each of the three seasons from each of the four zones during 2020-21. Immediately after procurement the samples were aseptically packed, suitably labelled and stored under icepacks and brought to the laboratory for its further analysis. The data on microbiological quality was categorized season-wise. The counts of aerobes, coliforms, Staphylococci, yeast and moulds and Escherichia were estimated. It was observed that the highest counts of the test organisms were observed in all the four zones in the samples collected during February to May and the lowest counts were recorded during October to January. It was observed that the highest average aerobic counts were recorded in North Maharashtra (93.21×10^5 cfu/g); the highest average coliform counts of 9.7 cfu/g were observed in Western Maharashtra; the staphylococci counts of 97.81 cfu/g and Yeast and mould counts of 188.91 cfu/g were reported in Marathwada. The highest average *Escherichia coli* counts of 5.44 cfu/g were recorded in Marathwada during Feb-May. The results on microbiological quality of *Paneer* sold in the four zones of Maharashtra reveals that the microbiological quality of Paneer sold in the state is well within the standards specified by the FSSR, 2011. It is concluded that the awareness campaigns about the hygienic practices implemented by various dairies and the authorities resulted into quantum improvement in the microbiological quality of dairy products like *Paneer* sold in the State.

Keywords: Paneer, Microbiology of paneer, FSSAI, Milk.

INTRODUCTION

India has shown impressive growth in the milk production, achieving an annual production of about 200 MMT in the year 2021-2022, while in Maharashtra annual milk production is about 12 MMT. India is among the world's largest and fastest growing market for milk and milk products as the source of first class proteins especially for children and vegetarians. It supplies most essential elements like calcium and phosphorus along with numerous other essential major and minor substances. Milk is a nutritious food (Kalyankar, *et al.*, 2016). India is a rapidly growing dairy product market, where in paneer market is growing at the rate of 8% with annual consumption of over 20,000 tons of paneer (Chaturvedi *et al*., 2018). Paneer has moisture content of 40-60%, protein biological value of 80-86 and protein content of 15-20%, and fat of 16-20% with rich source of minerals like calcium (Goel *et al.*, 2018). Milk and milk products are nutrient dense and provide nourishment to the ever growing human population. Surplus milk is converted into a variety of dairy products. The traditional Indian dairy products are an integral part of vast Indian heritage. Depending on various methods of processing, it possesses great social cultural and economic significance. It is estimated that about fifty percent of milk produced in the country is converted into dairy products such as *Khoa, Chhana, Paneer, Dahi, Ghee, Shrikhand* etc. Besides having strong foot hold in Indian market, these products have also great export potential because of presence of Indian diaspora across the globe.

India is currently inhabits about 18% of the world population, which is growing at the rate of 1.3% annually. The FAO's global dairy trends predict that as the income increases, the people prefer to spend a higher share of their food budget on animal proteins like dairy products than the food crops. Bovine milk contains about

3% protein, of which 80% is caseins and 20% is whey proteins (Kalyankar *et al*., 2016a). The past three decades have witnessed buoyant growth in the consumption of livestock products.

Paneer is one of the most important traditional dairy products, having continuous increasing trend in its demand. It retains all the milk constituents except soluble whey proteins, lactose, minerals, *Vit*. B-complex and plays an important role in the socio-economic and nutritional well-being of society. It is a heat and acid coagulated dairy product used as a base material for the preparation of large number of culinary dishes in almost all parts of the country. A high-quality block of paneer has a marble-white colour, a flavour that is sweet but somewhat acidic, a nutty scent, a spongy body, and a tightly woven and smooth texture (Ahirwar *et al.,* 2022). According to PFA (2010), *Paneer* is defined as a product obtained from the cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70% moisture and milk fat content shall not be less than 50% of the dry matter. The milk fat content of skim milk *Paneer* shall not exceed 13% on the basis of its dry matter content as per FSSAI.

The microbiological quality of *Paneer* prepared from various types of milks was studied by Jadhav (2016). It was observed that the product was heavily contaminated with bacterial and fungal contamination. Presence of Staphylococcus spp. and faecal coliforms are considered for poor hygienic conditions during *Paneer* making, handling and storage. Ghodekar (1998); Chopra (1998) suggested that the packaging material can extend the shelf life of *Paneer*.

Godbole *et al*. (2013) assessed the microbiological quality of *Paneer* sold in Nagpur city in Maharashtra. A total of 32 samples were collected from various areas in the city and analysed for total viable counts and yeasts and molds and for presence of *E. coli*, *Staphylococcus* spp, and *Salmonella* spp. It was observed that the aerobic counts ranged from 1×10^6 to 8.2×10^6 cfu/g, the fungal counts ranged from 1×10^5 to 6.6×10^5 cfu/g. It was further that the 97% samples were positive for *Staphylococcus spp*. and 72% and 34% samples were positive for *Salmonella spp*. and *E. coli*, respectively, which was attributed to the poor hygienic conditions during *Paneer* preparation, handling and storage. The study suggests the need for more strict preventive and control measures to avoid pre and post process contamination in milk food products (Dwivedi *et al.,* 2014).

In view of the aforesaid reported studies, the present investigation was planned and executed to ascertain the microbiological quality of *Paneer* sold in 22 districts under the four zones in Maharashtra, *viz.* Marathwada, Vidarbha, Western Maharashtra and North Maharashtra during 2020-21.

MATERIALS AND METHODS

Procurement of Paneer samples. Sixty samples of *Paneer*, 15 each from each of the four divisions *(*each sample of 50 g) from 22 districts of Maharashtra during three seasons (*Viz.* October to January, February to May and June to September) were aseptically procured using a simple randomized sampling method from Marathwada, Vidarbha, Western Maharashtra and North Maharashtra in Maharashtra during 2020-21. Samples from different brands and locally available popular manufacturers were collected randomly.

Preparation of Paneer samples for microbiological analysis. Immediately after procurement the samples were aseptically packed, suitably labeled and stored under icepacks and brought to the laboratory for its further analysis. Samples were prepared under aseptic conditions. A sanitized set of pestle and mortar was taken for macerating the sample. Approximately eleven gram of the *Paneer* sample was weighed aseptically in a sterile 100 ml glass beaker and it was transferred aseptically to the sanitized mortar with the help of a sterile stainless steel spatula. The sample was then macerated thoroughly by making a paste using small quantity of previously warmed (45°C) 99 ml of 2% sterile diluents and the contents were transferred to the same conical flask to obtain the first dilution *i.e*. 1:10. Subsequent dilutions were made accordingly.

Microbiological analyses. The microbiological quality in terms of the total aerobic counts (SPC) by using the nutrient agar medium (NA), coliform counts by using Violet Red Bile agar (VRBA), yeast and mold counts by using potato dextrose agar (PDA), Staphylococcal counts by using Staphylococcal agar (SA) and *Escherichia coli* counts by employing MacConkey's agar (MA) were estimated by applying the standard procedure (PFA, 2010). The data on microbiological quality was categorized season and zone-wise.

Statistical analysis. The data obtained on the microbial counts during various seasons and the zones was statistically analyzed by using descriptive statistics in this study, the Chi-squared test was performed to assess the relationship between the seasonal variation and variation in microbial counts of *Paneer* sold in different zones, the *P*-values < 0.05 were considered significant.

RESULTS AND DISCUSSION

The *Paneer* samples were collected randomly during three seasons from various shops in 22 districts under four different zones in Maharashtra. The results on microbiological quality of *Paneer* are presented in Table 1.

It could be seen from the data presented in Table 1 reveals that the overall average microbial counts of the five target group of organisms in all the four zones are seen to be highest during the months of Feb-May, followed by June-Sept. The lowest counts of all the five groups in the four zones are recorded during the Sept-Jan. These results are in close conformity with earlier findings (Goyal *et al*., 2007; Jadhav, 2016).

Table 1: Microbiological quality of *Paneer* sold in twenty two districts under four zones of Maharashtra.

Zones under study	Sampling months	Aerobic Plate Counts* (cfu/g)	Coliform Counts* (cfu/g)	*Staphylococcus aureus* counts* (cfu/g)	Yeast and Mold Counts* (cfu/g)	*Escherichia coli** (cfu/g)
Marathwada	June-Sept	66.23×10^4	7.8	82.22	147.30	3.08
	Oct-Jan	9.3×10^4	2.3	67.30	148.34	1.23
	Feb-May	37.82×10^5	9.1	97.81	188.91	5.44
Vidarbha	June-Sept	78.09×10^4	8.8	79.93	121.17	3.31
	Oct-Jan	25.7×10^4	4	69.95	131.04	0.99
	Feb-May	63.02×10^5	8.2	96.81	151.61	4.81
Western Maharashtra	June-Sept	11.81×10^5	6.9	80.44	144.62	3.52
	Oct-Jan	46.2×10^3	3.7	60.13	98.29	1.35
	Feb-May	71.31×10^5	9.7	78.08	123.09	5.01
North Maharashtra	June-Sept	14.11×10^5	7.4	76.62	149.83	4.17
	Oct-Jan	52.9×10^4	2.9	64.33	101.47	1.59
	Feb-May	93.21×10^5	8.6	91.21	150.66	4.21

It is further that the highest average aerobic counts recorded in North Maharashtra zone (93.21×10^5 cfu/g); the highest average coli form counts of 9.7 cfu/g were observed in Western Maharashtra; the staphylococci counts of 97.81 cfu/g and yeast and mould counts of 188.91 cfu/g were reported in Marathwada. The highest average *Escherichia coli* counts of 5.44 cfu/g were recorded in Marathwada zone during Feb-May. It appears that the guidelines suggested by Bhat *et al.* (2000) for improving the microbiological quality are followed by the *Paneer* manufacturers and handlers in the twenty two districts under the study reported in this publication. Unlike reported by Godbole *et al.* (2013), the study of these workers showed a high degree of bacterial contamination in *Paneer* sold in Nagpur city. However, the findings of these workers about the counts of coliforms, *Staphylococcus* spp. and *E. coli* in the numbers less than the limit prescribed by FSSAI (2010) in almost all the *Paneer* samples is in close conformity with the findings in the present study. It may be attributed to the practice of preparing and post preparing handling and storage of the product by following strict hygienic conditions.

One prominent and highly important finding emerged out of this study is the fact that by and large all the microbial counts recorded in the present investigation are well in conformity with the standards specified by the Regulatory Authorities and presented in Table 2.

Table 2: Prescribed microbial specifications/requirements for *Paneer.*

Aerobic plate count (cfu/g)		Coliform count		*Staph. aureus* count		Yeast & Mold count		*Escherichia coli* count	
M	M	m	M	m	M	m	M	m	M
1.5×10^5/g	3.5×10^4/g	10/g	100/g	10/g	100/g	50/g	$1.5x10^2$/g	<10/g	NA
Test methods	IS 5402/ ISO:4833	5401 Part 1/ ISO:4832		IS5887: Part 2 or IS5887 Part 8		IS:5403 or ISO:6611		IS5887: Part-I or ISO:16649-2	

The findings in this study are not in agreement with earlier findings that most of the times the vendors and workers in the shop have no knowledge of the practices and probable dangers if the food safety procedures and standards are not followed. The application of HACCP to identify the critical control points for coliforms and *Staphylococcus* spp. has indicated that the contamination is attributed to the product handlers using bare hands to remove excess water in *Paneer* as was earlier reported (Yadav *et al.*, 2009; Vijayalakshmi and Tamilarasi 2001).

CONCLUSION

It is concluded that the microbial counts of the target five groups of organisms reported in the *Paneer* samples procured randomly from twenty two districts under five zones of Maharashtra during three seasons are well within the prescribed limits by the Regulatory Authorities.

FUTURE SCOPE

This can be attributed to the awareness campaigns about the hygienic practices implemented by various dairies and the authorities resulted into quantum improvement in the microbiological quality of dairy products like *Paneer* sold in the State of Maharashtra.

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Conflict of Interest. None.

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