IJPSR (2018), Volume 9, Issue 9 **(Research Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 27 December, 2017; received in revised form, 16 February, 2018; accepted, 04 March, 2018; published 01 September, 2018

MICROBIOLOGICAL STUDY OF INDIAN PANEER - A CASE STUDY OF DELHI CITY

Nitin Girdharwal

Department of MBA, KIET Group of Institutions, Ghaziabad - 201206, Uttar Pradesh, India.

Keywords:

Paneer,
Sensory characteristics,
Chemical quality, Marketing,
FSSAI, Microbiological quality

Correspondence to Author:
Dr. Nitin Girdharwal

Associate Professor,
Department of MBA,
KIET Group of Institutions
Delhi - Meerut Road, Ghaziabad - 201206, Uttar Pradesh, India.

E-mail: Nitin.girdharwal@kiet.edu

ABSTRACT: Paneer has great value in diet because it is a rich source of high quality proteins, fat, and minerals. Paneer has a short life span of 2-3 days of refrigeration storage, but freshness of the product is lost after one day. So, the present study was carried out to know the quality of different brands of paneer sold in Delhi City. A total of 80 packets of eight different brands were analyzed for their quality. Wide variation in chemical composition like moisture (49% to 64%), fat (13.5% to 24%), protein (18% to 23%) and lactose (1.75% to 4.23%) existed in the samples. Total bacterial count was observed between 25.40 and 41.10 × 10^4/gm, yeast and mold count was observed to be 13.75 and 20.90 × 10^1/gm, coli-form count was 3.95 to 7.65 × 10^1/gm and *Staphylococcus aureus* count was 1.10 to 2.20 × 10^1/gm. Instrumental hardness value varied between 27.56 and 62.22 N. About 75% of the brands did not conform to Food Safety and Standards Authority of India Act (FSSAI) labeling requirements. It is said that India is the largest producer of milk in the world, but improvisations like more awareness about FSSAI Act with respect to packaging, labeling, chemical, microbial requirements, *etc*. have to be brought about. Further, more hygienic environment during the production of paneer by establishing pre-requisite programs like good manufacturing techniques, good hygienic practices, and Hazard Analysis Critical Control Programme have to be created by manufactures to bring out utmost quality products in the market.

INTRODUCTION: Paneer is an important indigenous dairy product prepared by the heat and acid coagulation of milk. According to Food Safety & Standard Authority of India, FSSCI [1], paneer means the product obtained from 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 50.0% of the dry matter. Paneer has great value in diet because it is a rich source of high quality proteins, fat, minerals, and vitamins.

QUICK RESPONSE CODE

DOI:
10.13040/IJPSR.0975-8232.9(9).4008-14

Article can be accessed online on:
www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.9(9).4008-14

It is used widely as a base raw material for the preparation of various culinary dishes and snacks. Paneer is made up of protein and fat, insoluble salts and colloidal materials, as well as part of the moisture of the original milk, which contains lactose, whey proteins, soluble salts, vitamins and other milk components, Kanawjia, Roy and Singh, 1996 [2]. It has been found that about 4-5% of the total milk produced in India is converted into paneer. Paneer has a short life span of about 2-3 days at refrigeration storage without much deterioration in the quality, but freshness of the product is lost after 1 day, Dhankhar, 2014 [3].

Hence, cold chain is a must for paneer marketing and at the retailer's end, it has to be foolproof. The problem of quality maintenance of food products sold in the market has been persisting for a long time. Unscrupulous entrepreneurs try to manipulate the paneer productions and quality with a sole

intention of profit generation, disregarding consumer concerns. Gullible consumers are exploited because of their ignorance or their blind faith in the law enforcing agencies. However, for the controlling agencies like Ministry of Health and Family Welfare under whose administration Food Safety and Standards Authority of India (FSSAI) comes, inspecting and monitoring the huge quantity of products sold in the market is by any means a daunting task. Ensuring quality foods in the market should actually be a consumer movement and needs to be monitored by active and pragmatic consumer courts.

Though food inspectors strive to continuously monitor the food quality in the market. It is indeed an unenviable task keeping in view the number of brands, number of retailers, and the vulnerability of our laws. Hence, it is the duty of all those concerned with food production, marketing, and consumers to keep a table on the quality of food products sold in the market. Academic and research institutions too have to share this responsibility. This is more so in case of perishable food items like milk, paneer, *etc*. Survey works have been conducted from time to time on the quality of food products in the market, for example, on paneer Desale, Dhole, Deshmukh and Nimase, 2009 [4], khoa sweets, Tarnbekar and Bhutda, 2016 [5] *etc*.

Solanki and Sheth [6] undertook a study to analyze the influence of nutritional information provided on the packages of ready-to-eat food products on the product evaluation and buying behaviour of consumers in Rajkot. Sadia, Jabbar, Deng, Hussain, Riffat, Naveed and Arif conducted a survey on occurrence of aflatoxins in sweets in Punjab. Similar work was reported by Iqbal and Asi, 2013[7]. Such works help in knowing the present status of the quality of food products that consumers get to buy and eat in different regions. The present study was carried out to know the quality of paneer being sold in Delhi.

In Delhi which is fast acquiring a cosmopolitan nature and in which social demography is changing like it is in other metro cities in India, the paneer market is growing. However, problem of substandard paneer being sold is always felt because paneer production is not considered as a profit generating venture.

MATERIALS AND METHODS: The present study was carried out to know the quality of different brands of paneer being sold in Delhi City for the following quality parameters: sensory quality of all paneer samples (colour, body and texture, and flavour), chemical quality (moisture, fate, protein, lactose, mineral, acidity% and pH), microbial analysis (total bacterial count, yeast and mold count, coli-form count, *Staphylococcus aureus* count and *E. coli* as well as Salmonella dectection) and textural quality (instrumentally measured adhesiveness, cohesiveness, springiness, chewiness and resilience). The study was carried out during October 2016 - November 2017.

Collections of Paneer Samples from Delhi Market: Sampling of different brands of paneer was done randomly in the market of Delhi City. Since Delhi is a metropolitan City with a good distribution network, the sampling area was divided into North and South Delhi. From North Delhi, four outlets and from south Delhi, four shops were chosen based upon the availability of brands.

Paneer samples were collected from different outlets in Delhi City (South and North Delhi). The refrigerated packages were put in ice box and brought to the laboratory for analysis. In all, eight brands of paneer were purchased totaling to 80 samples. As soon as the samples were brought to the laboratory, the following details on the packages were recorded: weight, cost, nutritional labeling, FSSAI license logo, manufacturer's address, *etc*. The packets were cut open and the appearance and colour were noted.

The paneer blocks were cut into 1 cm cubes and tempered to room temperature and evaluated for sensory acceptance. The cut paneer cubes were also used for textural and chemical analysis. For microbial analysis, the packets were cut open under sterile laminar flow conditions and sample drawn for microbiological dilution preparations. These dilutions were used for plating purposes. No differentiation was made between fresh or stored samples; however, all the packets were collected before use by date.

Sampling Plan: The sampling plan is depicted below:

TABLE 1: THE SAMPLING PLAN

Brand	Retail outlet-1	Retail outlet-2	Retail outlet-3	Retail outlet-4	Retail outlet-5	Retail outlet-6	Total
A	10	0	0	0	0	0	10
B	0	3	1	3	0	3	10
C	0	2	3	1	3	1	10
D	0	1	3	3	2	1	10
E	0	4	1	1	2	2	10
F	0	3	4	1	2	0	10
G	0	3	3	1	1	2	10
H	0	0	2	2	3	3	10
Total	10	16	17	12	13	12	80

Sensory Evaluation: Each block of paneer was cut into about 1 cm small cubes. The paneer samples were tempered to room temperature before judging. Samples were served to judges in Petri dishes which were coded to conceal the identity of source. The orders of presentation of samples were randomized across subjects. Subjects judged a maximum of four samples in the one session. The judges consisted of Institute staff and interested and motivated students - all of whom were well aware of desirable qualities of paneer. The quality of paneer samples were evaluated on a 9 - point hedonic scale, Lawless and Heymann, 2010, 8 for colour and appearance, flavour and body and texture.

Chemical Analysis: Moisture was determined by gravimetric method BIS, 1983 [9] and protein was determined by Kjeldahl method, AOAC, 2005 [10]. Lactose was derived by difference of sum total of the major constituents like moisture, protein, fat, and ash from 100 as described by AOAC [11]. The Ash content of paneer was estimated by the method of BIS (1981). Acidity was determined by the method described by BIS [12].

Microbial Analysis: The samples for micro-biological analysis were prepared under aseptic conditions. A sanitized set of pestle and mortar was taken for macerating the sample. Approximately 11 gm 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 (45ºC) 99 ml of 2% sterile diluents and the contents were transferred to the same conical flask to obtain first dilution (1 : 10).

Further dilutions were prepared using 9 ml quantity of citrate buffer from the first dilution as per the requirements. The dilutions were used immediately for plating purpose. Total viable count, yeast and mold count, and coli-form counts of paneer were determined according to BIS (1981) with modification except that the diluent used was 2% sodium citrate. *Staphylococcus aureus* count, *E. coli* count of paneer and Salmonella detection was carried out as per the method described in AOAC 2015 [13] with modification except that the diluent used was 2% sodium citrate.

Texture Profile Analysis (Bourne, 1978): Texture analyzer (Stable Microsystems, UK) was used for measuring the hardness, cohesiveness, adhesiveness, springiness, gumminess, chewiness and resilience of paneer at 30 ºC with size of 20 cm^3 cubes. The test conditions maintained were: load cell capacity 5 kg, platen probe (P/75) with 7.5 mm diameter, pre-test speed 1 mm/sec, test speed 5 mm/sec, post-test speed 5 mm/sec, target mode - distance, distance - 5 mm, time - 30 sec, trigger type - auto force - 2 gm, break made - off, and tare mode - auto.

RESULTS AND DISCUSSION: The various physiochemical and microbial parameters of paneer samples were tabulated and analyzed.

Sensory Characteristics of Paneer Samples: It was observed that sensory score of samples varied from brand to brand (**Table 2**).

TABLE 2: SENSORY ACCEPTANCE SCORES*(±SD) OF PANEER SAMPLES COLLECTED FROM DELHI CITY

Brand	Appearance	Flavour	Body Texture	Overall Acceptability
A	7.4 ± 0.3^{BC}	7.5 ± 0.1^{B}	7.5 ± 0.1^{B}	7.5 ± 0.1^{B}
B	7.7 ± 0.1^{BCD}	7.4 ± 0.1^{B}	7.5 ± 0.1^{B}	7.4 ± 0.1^{B}
C	7.8 ± 0.1^{D}	7.3 ± 0.3^{B}	7.4 ± 0.1^{B}	7.5 ± 0.2^{B}
D	7.6 ± 0.4^{CD}	7.6 ± 0.1^{B}	7.6 ± 0.2^{B}	7.6 ± 0.2^{B}
E	7.4 ± 0.1^{B}	7.7 ± 0.1^{B}	7.6 ± 0.1^{B}	7.6 ± 0.1^{B}
F	7.4 ± 0.3^{D}	7.6 ± 0.2^{B}	7.6 ± 0.2^{B}	7.5 ± 0.1^{B}
G	7.7 ± 0.0^{BCD}	$7. \pm 0.1^{B}$	7.6 ± 0.0^{B}	7.6 ± 0.0^{B}
H	6.9 ± 0.1^{A}	5.7 ± 0.1^{A}	6.2 ± 0.2^{A}	6.3 ± 0.1^{A}

Values with different superscripts in a row are significantly different from each other ($p < 0.05$); Mean of 10 samples

The visual colour of paneer samples varied from whitish to slightly yellowish white. Fresh paneer usually has a spongy compact body and smooth texture. Some paneer brands seemed to be very hard while some paneer brands seemed very soft, but some brands had very acceptable body and texture. However, there were some paneer brands seemed very soft, but some brands had very

acceptable body and texture. However, there were wide variations in body and texture from brand to brand.

Chemical Quality of Paneer Samples: It was observed that brand "H" showed the highest moisture content as compared to other brands whereas brand "G" showed lowest moisture content among all samples **Table 3**. Rest of the brands showed moisture content within the limits of FSSAI standards **Table 4**. The average moistures of paneer were 53 - 55% as reported by Kanawjia and Singh 2016 [14]. With regard to fat content, brand "C" showed highest fat content as compared to other brands; whereas, brand "H" showed lowest fat content as compared to all other brands. From analyzed observations, brand "A", "G," and "H" did not conform to FSSAI standards **Table 4**.

For protein content, brand "A" showed highest protein content as compared to other brands; whereas, brand "B" showed lowest protein content as compared to other brands. Rest of the brands showed near about same protein content with minimum variation. Brand "A" showed highest lactose content among all brands; whereas, brand "B" showed lowest lactose content among all brands. Rest of the brands showed near about same lactose content with minimum variation (**Table 3**).

TABLE 3: CHEMICAL COMPOSITION (± SD) OF PANEER COLLECTED FROM DELHI CITY

Brand	Fat%	Moisture%	Protein%	Ash%	Lactose%	Acidity%	pH
A	23.05 ± 1.11 ^{BC}	52.29 ± 1.00 ^{ABC}	23.81 ± 1.39 ^{E}	1.62 ± 0.16 ^{AB}	1.43 ± 1.12	0.48 ± 0.12 ^{A}	6.05 ± 0.13 ^{F}
B	22.64 ± 1.28 ^{B}	56.53 ± .21 ^{D}	17.14 ± 1.27 ^{A}	1.74 ± 0.50 ^{B}	2.02 ± 0.56	0.47 ± 0.12 ^{A}	5.50 ± 0.25 ^{BC}
C	24.90 ± 1.79 ^{C}	51.91 ± 1.79 ^{ABC}	17.88 ± 1.25 ^{AB}	1.65 ± 0.05 ^{AB}	3.64 ± 1.60	0.61 ± 0.18 ^{AB}	5.85 ± 0.08 ^{DE}
D	23.30 ± 0.87 ^{BC}	53.54 ± 1.69 ^{BCD}	18.68 ±1.0 ^{BC}	1.59 ± 0.5 ^{AB}	2.94 ± 2.25	0.34 ^{AB} ± 0.54	0.20 ^{AB} ± 5.37
E	23.45 ± 1.89 ^{BC}	54.84 ± 2.42 ^{CD}	17.96 ± 0.44 ^{AB}	1.65 ± 0.05 ^{AB}	2.09 ± 0.71	0.69 ± 0.13 ^{BC}	5.76 ± 0.09 ^{D}
F	24.35 ± 2.42 ^{BC}	5137 ± 1.98 ^{AB}	19.51 ± 1.18 ^{C}	1.48 ± 0.11 ^{A}	3.78 ± 2.61	0.57 ± 0.14 ^{AB}	5.78 ± 0.13 ^{D}
G	23.55 ± 0.93 ^{BC}	49.92 ± 3.17 ^{A}	22.17 ± 1.24 ^{D}	1.62 ± 0.13 ^{AB}	3.33 ± 2.94	0.55 ± 0.13 ^{AB}	5.65 ± 0.18 ^{CD}
H	13.65 ± 0.74 ^{A}	64.29 ± 2.27 ^{F}	17.76 ± .06 ^{AB}	1.68 ± 0.09 ^{AB}	3.2 ± 2.29	0.83 ± 0.32 ^{C}	5.15 ± 0.07 ^{A}

Values with different superscripts in a column are significantly different from each other ($p < 0.05$); Mean of 10 samples

The lactose content depends upon the time for which coagulum is kept in chilled water before packaging. During soaking in chilled water, some of the lactose gets drained into the soaking water. For acidity, brand "H" showed unacceptably higher acidity among all brands; whereas brand "B" showed lowest acidity, which was most acceptable as compared to other brands (**Table 4**). Desale *et al*., [15] also reported wide variation in chemical quality of paneer from different brands sold in Ahmednagar City. Rajorhia, Pal and Arora 1984 also reported wide variations in chemical quality of different brands of paneer collected from Karnal and Delhi as compared to NDRI made paneer.

TABLE 4: MOISTURE AND FAT PERCENTAGES (±SD) OF PANEER SAMPLES COLLECTED FROM DELHI CITY VIS A VIS FSSAI STANDARDS

Brand	According to FSSAI	Analyzed Moisture	Conform to FSSAI	According to FSSAI	Analyzed Fat	Conform to FSSAI
A	NOT > 70	52.29 ± 1.00	√	NOT > 50	43.91 ± 3.85	×
B	NOT > 70	56.53 ± 2.21	√	NOT > 50	51.91 ± 2.03	√
C	NOT > 70	51.91 ± 1.79	√	NOT > 50	51.82 ± 2.50	√
D	NOT > 70	53.54 ± 1.69	√	NOT > 50	50.19 ± 2.01	√
E	NOT > 70	54.84 ± 2.42	√	NOT > 50	50.00 ± 4.51	√
F	NOT > 70	51.37 ± 1.98	√	NOT > 50	51.35 ± 6.81	√
G	NOT > 70	49.92 ± 3.17	√	NOT > 50	46.78 ± .18	×
H	NOT > 70	64.29 ± 2.27	√	NOT > 50	38.56 ± 3.67	×

Ghodekar (1989) concluded that quality of paneer depended upon factors such as type of milk, fat percentage, moisture content, heat treatment of milk, type of coagulant, and microbial contamination. It was also concluded that shelf life and yield of paneer could be increased by lowering moisture content to 50 - 55%, reducing fat content to 42% (DM basis), and using sour whey, HCl, H_3PO_4 or acidophilus whey as coagulant. Boghra and Mathur (1991) reported wide variations in fat, moisture, and ash contents.

Microbiological Quality: TBC counts of paneer samples were in the range of 25.40 41.10×10^4

colony forming units (CFU)/gm, yeast and mould count 13.75 - 20.90 × 10^1 CFU/gm, coli-form count 3.95 - 7.65 × 10^1 CFU/gm and *Staphylococcus aureus* count 1.10 - 2.20 × 10^1 CFU/gm **Table 5**.

TABLE 5: MICROBIAL COUNTS*(±SD) OF PANEER SAMPLES COLLECTED FROM DELHI CITY

Brand	TBC (10^4)	Y and M (10^1)	Coliform (10^1)	*S. aureus* (10^1)
A	39.95 ± 3.71	18.70± 6.72	7.65± 2.99	1.85± 1.61
B	28.55± 8.13	108.55± 5.14	5.85± 2.74	1.85± 1.36
C	27.70± 8.13	17.75± 4.24	4.15± 2.93	1.60± 1.41
D	27.40± 3.64	18.85± 4.94	6.85± 3.07	1.65± 1.55
E	30.75± 9.75	13.75± 3.68	3.95± 2.71	1.80± 1.96
F	28.25± 4.59	15.50± 4.41	5.25± 2.29	1.14± 1.56
G	35.87± 6.60	16.70± 4.08	3.65± 2.30	1.85±.10
H	43.10± 4.20	20.90± 2.49	5.25± 2.05	2.20±.121

*Mean of 10 samples

The presence of coli form and *S. aureus* has to be noted because these reflect the hygienic nature of paneer handling. Godbole (2013) found that 32 samples had bacteriological count ranging from 1×106 to 8.2×106 CFU/gm; fungal count ranged from 1×105 – 6.6 × 105 cfu/gm and 97% samples got *Staphyloccus sp*. *E. coli* in 72% and *Salmonella sp.* were found in 34% of the samples. They suggested that there was a need for more strict preventive control measures to avoid pre and post process contamination. Desale *et al*., (2009) reported wide variation in microbial quality of paneer from different brands sold in Ahmednagar City. Vaishnavi *et al*., 2016 [16] reported that paneer samples sold in Chandigarh City were highly contaminated with microorganisms. In the present study, brand "A" and "H" did not conform to FSSA standards for TBC. For other microbial analysis like yeast and mold, coli form, *Staphylococcus aureus* and Salmonella, all brands conformed to FSSAI standards **Table 6**.

TABLE 6: MICROBIAL COUNTS OF PANEER SAMPLES COLLECTED FROM DELHI CITY VIS A VIS FSSAI STANDARDS

Brands	TBC	Y & M	Coliform	*S. aureus*	*E. coli*	Salmonella
A	×	√	√	√	√	√
B	√	√	√	√	√	√
C	√	√	√	√	√	√
D	√	√	√	√	√	√
E	√	√	√	√	√	√
F	√	√	√	√	√	√
G	√	√	√	√	√	√
H	×	√	√	√	√	√

Instrumentally Measured Attributes: Hardness value of brand "G" was highest among all brands; whereas brand "H" showed lowest hardness value, meaning that brand "H" was the softest paneer among all brands **Table 7**. This variation could be attributed to several factors like quality of milk used for paneer because of conformational changes as reported by Kanawajia and Singh in 1996. Bargale and Jha 2015 [17] concluded that as the storage period increased, hardness, chewiness, and gumminess increased significantly, while springiness and cohesiveness remained almost unchanged. In this study, for cohesiveness, brand "F" showed highest value except brand "H" and brand "G" showed lowest cohesiveness value.

TABLE 7: INSTRUMENTALLY MEASURED TEXTURAL CHARACTERISTICS (±SD) OF PANEER SAMPLES COLLECTED FROM DELHI CITY

Brand	H	Adh	Co	Spr	Gum	Chew	Res
A	50.1±8.50^{bc}	0.63±0.68^{a}	0.59±0.11^{ab}	0.79±0.16^{a}	29.98±7.70^{c}	23.41±7.70^{bc}	4.26±1.42^{ab}
B	39.63±9.71^{ab}	0.59±1.04^{a}	0.55±0.11^{ab}	0.88±0.05^{a}	21.78±6.04^{abc}	19.31±5.40^{abc}	3.74±0.82^{a}
C	30.40±12.22^{a}	1.74±4.24^{a}	0.53±0.19^{ab}	0.81±0.17^{a}	16.52±8.16^{ab}	14.22±6.76^{ab}	3.27±0.79^{a}
D	31.18±4.91^{a}	0.47±0.37^{a}	0.54±0.07^{ab}	0.78±0.04^{a}	16.85±2.87^{ab}	13.25±2.76^{ab}	4.87±0.82^{ab}
E	58.95±11.15^{c}	0.28±0.30^{a}	0.51±0.07^{ab}	0.82±0.04^{a}	30.96±9.68^{c}	25.63±.74^{d}	4.54±0.77^{ab}
F	41.79±0.85^{ab}	0.85±1.73^{a}	0.64±0.08^{b}	0.83±0.04^{a}	27.24±8.30^{bc}	22.96±7.80^{bc}	3.55±0.62^{a}
G	62.22±13.38^{c}	0.70±2.08^{a}	0.47±0.09^{ab}	0.76±0.08^{a}	30.59±11.58^{c}	24.00±11.21^{bc}	5.77±1.96^{b}
H	27.56±6.29^{a}	0.51±0.62^{a}	0.46±0.16^{a}	0.86±0.05^{a}	12.43±4.94^{a}	11.37±5.07^{a}	5.03±2.00^{ab}

Values with different superscripts in a column are significantly different other ($p<0.05$); *Mean of 10 samples

Labeling Aspects of paneer Packages: As per FSSAI regulations, every package of food product sold in the market has to conform to certain labeling specifications (FSSAI, 2015). Eighty packets of the eight brands were analyzed for compliance to FSSAI labeling requirements such as FSSAI licensing number, ingredient declaration, permitted additives, expiry date, manufacturing date, and quantity of composition in gm/mg *etc*.

It was observed that brands "B", "D", "F", "G", and "H", did not conform to FSSAI labeling requirements **Table 8**. The non-conformations were smaller size of FSSAI license declaration, claim of paneer as cottage cheese, claim of the product as low fat against the declaration of high fat content, and description of ingredients in units other than prescribed by FSSAI.

TABLE 8: COMPLIANCE OF PACKAGED PANEER SAMPLES COLLECTED FROM DELHI CITY TO FSSAI LABELING REQUIREMENTS

Brand	Labeling Requirements							
	FSSAI Licensing Number	Ingredient Declaration	Permitted Additives	Best Before Date	FSSAI Logo Format	Manufacturing Date	Quantity of composition (gm/mg)	Company Address
A	No Label	No Label	No Label	No Label	No Label	No Label	No Label	No Label
B	√	√	√	√	×	√	√	√
C	√	√	√	√	√	√	√	√
D	×	√	√	√	×	√	√	√
E	√	√	√	√	√	√	√	√
F	√	√	√	√	×	√	√	√
G	×	√	√	√	×	√	×	√
H	√	√	√	√	×	√	×	√

Managerial Implications: Paneer is a low shelf life product which needs a cold chain, right from the manufacture point to retail sale point. The efficacy of cold chain maintenance actually decides the quality of paneer sold in the market. Thus, it is understood that the quality of paneer sold in the market is not only dependent upon the manufacturing technique, but also on the persons down the line up to the retail seller. The results presented in the study throw some light on how the quality of paneer varies widely, even though manufacturing technique more or less remains the same in all the dairies. Some of the factors identified are: maintenance of cold chain at below 10ºC, no exposure of product to ambient temperature and sun, careful handling of the packages, *etc*. These are management factors controlling the quality of paneer that goes into the hands of consumers. The result of the present study would also help in formulating proper standards of paneer. For example, moisture content in paneer sold in various outlets never exceeded 64% whereas the moisture legally allowed in paneer is up to 70%.

Further, the higher the moisture content, the higher is the microbial load and shorter is the shelf life. The results obtained in the study give us an idea of the type of paneer consumed by people in the country in general and Delhian in particular. This would create awareness among consumers about paneer quality. By the conducted study such as the present one. the technical officers who supervise paneer manufacture in dairies will also be adopting innovative techniques of marketing, for example, better packaging systems, better refrigeration facilities, guidance to consumers about better ways of utilization of paneer, awareness among retailers about cold chain maintenance, product characteristics and awareness about legal implications.

CONCLUSION: In this study, it is observed that 75% of the brands were not conforming to FSSAI labeling requirements. In chemical analysis, it was observed that 37% of the brands showed percent fat value less than FSSAI standard. In microbial analysis, 25% brand showed TBC count more that FSSAI requirements. With regard to TPA Parameters, brand "G" was found to be the hardest paneer; whereas, brand "H" was observed to be the softest paneer among all brands. This shows possibilities of non-conformations of a few paneer samples being sold in Delhi market to FSSAI regulations, meaning that some consumers are getting sub-standard quality of paneer. Detailed studies are to be further carried out by FSSAI to verify and confirm non-conformations and bring about consumer awareness to legal standards of paneer.

Limitations of the Study and Scope for Further Research: This study on the quality of paneer being marketed was confined to the market of Delhi City. Although Delhi is a cosmopolitan city with a huge market, the trend of paneer sales and quality may not be true reflections of the country's market as a whole. However, results definitely indicate a trend. Moreover, paneer is being prepared in the country using different types of milk namely, cow milk, buffalo milk, goat milk, and mixtures of them, Hence, paneer quality varies from region to region, and accordingly, its marketing scope also varies. Further, paneer is not yet a widely consumed product in southern parts of India as is the case in northern parts of the country. However, it is being viewed as premium products.

As scope for further research, marketing study of paneer may be conducted in different parts of the country, and results may be collated to arrive at any definite conclusions about quality of paneer being

sold throughout the country. However, such studies are time consuming and suffer from budgetary /financial constraints. Hence, such daunting tasks, that are beneficial to consumers, have to be taken up or sponsored by agencies like Food Safety and Standards Authority of India, which by constitution has the responsibility to assure unadulterated and best quality food products of India consumers, of course. Such tasks cannot succeed without active involvement of consumers and related forums.

ACKNOWLEDGEMENT: Dr. Nitin wishes to express gratitude to the Almighty and parents for their blessings.

CONFLICT OF INTEREST: The author declares that there is no conflict of interests regarding the publication of this manuscript.

REFERENCES:

1. FSSAI: The prevention of food Adulteration Act, 2006 Delhi; Professional Book Publishers, Edition 2,Vol 1, 2015; 151-178.
2. Kanawjia SK and Singh S: Paneer technology and its diversification. Indian Dairyman, 1996; 42(9): 390-393.
3. Dhankhar: Qualitative comparative assay of different paneer samples. International Journal of Engineering Science Invention 2014; 3(3): 27-30.
4. Desale RJ, Dhole PT, Deshmukh AR and Nimase RG: Studies on quality evaluation of market paneer. Asian Journal of Animal Science 2009; 4(1):73-74.
5. Tarnbekar DH and Bhutda SA: Prevalence of bacterial pathogens in pedha sold in Amravati (India). International Journal of Dairy Science 2016; 1(1): 32-35.
6. Solanki S and Sheth: Healthy food selection: The role of nutritional information of packaged foods on consumers' purchases intentions. Indian Journal of Marketing 2015; 45(9): 37-54.
7. Iqbal SZ and Asi MR: Assessment of aflatoxin in milk and milk products from Punjab, Pakistan Food Control 2013; 30(1): 235-239.
8. Lawless HT and Heymann H: Sensory evaluation of food: Principles and Practices: New York; Springer, Second Edition 2016.
9. BIS.IS: 10484 Paneer (FAD 19: Dairy products and equipment). Manak Bhawan, New Delhi: Indian Standard Institution 1983; 4(2): 54-59.
10. AOAC: Official methods of analysis of the Association of Official Analytical Chemists. Washington DC: AOAC International, Edition 18th, 2005; 4(1): 74-79.
11. AOAC Official methods of analysis of the Association of Official Analytical Chemists. Washington DC: AOAC International, Edition 19th, 2010; 5(2); 31-39.
12. BIS.IS: 10484 Paneer (FAD 19: Dairy products and equipment). Manak Bhawan, New Delhi: Indian Standard Institution 1983; 2(1): 21-25.
13. AOAC, Official method of analysis of the Association of Official Analytical Chemists. Washington DC: AOAC International, Edition 19th, 2015: 4(1): 91-97.
14. Kanawjia SK and Singh S: Sensory and textural change in paneer during Storage. Buffalo Journal 2016; 12(3): 329-334.
15. Desale and Nimase RG: Studies on quality evaluation of market paneer. Asian Journal of Animal Science 2009; 4(1): 73-74.
16. Vaishnavi C, Singh S, Grover R and Singh K: Bacteriological study of Indian Cheese sold in Chandigarh. Indian Journal of Medical Microbiology 2016; 19(4): 32-35.
17. Bargale PC and Jha K: Changes in the instrumental texture profile of pasteurized tofu (soy paneer) during storage. Indian Journal of Dairy Science 2015; 45(8): 429-431.
18. Mhatre SS, Jain SK, Murdia LK and Jain HK: Effects of different coagulation temperatures on the texture and yield of soy paneer. International Journal of food Engineering 2016; 4(8): 42-48.
19. IS: 1224 Determination of fat by Gerber method. (Part 1). Milk (Fifth Revision). Manak Bhawan, New Delhi: Indian Standard Institution, BIS, 2015.
20. Methods of sampling and microbiological examination. Handbook of food analysis, SP: 18 Part XI dairy products. Manak Standard Institution, BIS, 2016.
21. Boghra VR and Mathur ON: Chemical quality of some marketed indigenous milk products - I. Major constituents and mineral composition of paneer. Journal of Food Science and Technology 2014; 28(1): 57-58.
22. Karthikeyan N and Pandiyan C: Microbial quality of khoa and khoa based milk sweets from different sources. International Food Research Journal 2013; 20(3): 1443-1447.
23. Rojorhia GS, Pal D and Arora KL: Quality of paneer marketed in karnal and Delhi. Indian Journal of Dairy Science 2017; 37(3): 274-276.
24. Maier RM, Pepper IL and Gerba CP: Microbiology, Academic Press, Edition 2nd, 2017.

How to cite this article:
Girdharwal N: Microbiological study of Indian Paneer - a case study of Delhi city. Int J Pharm Sci & Res 2018; 9(9): 4008-14. doi: 10.13040/IJPSR.0975-8232.9(9).4008-14.