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Organoleptic and probiotic quality of curd as affected by the preparation techniques used by the households and commercials of urban Vadodara

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ABSTRACT

Thirty households and 30 commercials were studied for their consumption and preparation techniques using semi structured questionnaire. The results showed that 73% of the subjects consumed curd on daily basis. The curd preparation techniques followed by the subjects of both households and commercial settings differed in the type of milk, source of milk, washing techniques of utensils used for curd setting and curd storage practices. The organoleptic scores showed that branded curd scored higher than hoseholds and other commercial outlets. All the curd samples analyzed had adequate number of probiotic bacteria *i.e.* in the range of $5.1x10^{10} – 1.2x10^{11}$ for Lactobacilli and *Streptococcus thermophilus* and $2x10^{8} – 7.5x10^{8}$ for *Bifidobacteria*. required for alleviating various health problems. Higher counts of *E. coli* and *Shigella* were detected in commercial curds as compared to household curds. Curds of all households and commercials except branded samples were contaminated with *L. brevis* and *L.curvatus* that resulted in low scores for flavour and texture.

Key words : Fermented milk, Probiotic cultures, Organoleptic qualities, *E.coli*, Shigella, Salmonella

Curd, traditionally known as Dahi is known to have high medicinal values in Ayurveda and have utmost importance in Indian diet. It is traditionally prepared at household levels but now-a-days it is available commercially too. Around 9.1% of total milk produced in India is converted in to curd and this sector is showing an annual growth rate of more than 20% per annum (Garg, 1988). Curd is generally prepared domestically by traditional method which involves inoculating boiled and cooled milk with a day old curd and held at ambient temperature in preferably earthen pots until it sets into a curd which may take 12 to 24 hours (Singh, 2006).

A good quality curd is firm with uniform consistency, sweet aroma, mild acid taste and smooth glossy surface (Keith, 1985). During preparation and handling of curd, poor quality milk, unhygienic practices associated with the process and use of wild type of starter culture may give rise to poor grade curd (Masud *et al.*, 1991).

However, curd is the only uncooked fermented product consumed and recently a lot of interest is generated about the probiotic content of fermented foods. Probiotics are the live probiotic cultures when ingested in right numbers, beneficially affect the host by improving its intestinal microbial balance. Friend and Shahni (1984) and Sanders (1999) showed a positive physiological impact of probiotic bacteria on the biomarkers of diarrhea, lactose intolerance and colon cancer when daily dose of $10^{9} – 10^{10}$ probiotic organisms were consumed (*i.e.* intake of 100ml yogurt per day). Curd being widely consumed in this country, its probiotic status needs to be studied in both terms of its number and viability to conclude about its ability to serve as probiotic food. Several undefined Lactobacilli species are known to be involved in curd making. However, its effect on quality of curd remains a mystery. Therefore, this study was designed to survey curd consumption and preparation technique preferred by households and commercial settings in urban Vadodara along with determination of its probiotic and organoleptic qualities.

METHODOLOGY

Thirty households belonging to various ethnic groups and 30 commercial outlets willing to participate in the study were selected from urban Vadodara. The data regarding curd consumption pattern, curd preparation techniques and sanitation and hygienic practices prevailed by the households and commercials were collected using semi structured preteseted questionnaire.

Sample collection for determining pH and probiotic quality:

On the basis of data obtained from curd consumption and curd preparation techniques, 40 curd samples were collected for determination of probiotic and organoleptic quality. Twenty household curd samples out of which 5 each of ethnic groups (North Indian, South Indian, Bengalis, Gujaratis and Marathis) and 20 commercial curd samples from branded curds, local dairies, restaurants and

hostels were collected.

Organoleptic evaluation:

The organoleptic evaluation of the curd samples was carried out by the 15 trained panel members. Samples were given random codes and were assessed for various parameters like colour, flavour, consistency and absence of defects using Composite Scoring test.

Microbiological analysis:

The samples were plated on the respective media as per the methods of DeMan *et al*., 1960 and Hi Media Manual, 2003) for the selective enumeration of Lactobacilli, *S. thermophilus, Bifidobacteria, Salmonella, Shigella and E. coli.* The Lactobacilli isolates were further analyzed for their species identification using Hi Media biochemical test kits for carbohydrate fermentation. The Lactobacilli were treated with 12 different carbohydrates (Lactose, Xylose, Maltose, Fructose, Dextrose, Galactose, Raffinose, Trehelose, Melibiose, Sucrose, L- Arabinose, and Mannose). The results obtained were matched with Lactobacilli species identification chart from Bergey's Manual (Buchanan and Gibbsons, 1974)

Statistical analysis:

The results of curd consumption and preparation techniques along with sanitation and hygienic methods at both households and commercials were statistically analyzed using Chi square. The results of organoleptic parameters and probiotic counts were analyzed using one way ANOVA between groups with curd samples as variable factor. The 't' test was used to find significant difference between the probiotic counts of household and commercial curd samples. Pearson's Correlation coefficient was calculated between the organoleptic qualities and pH, probiotic counts and pH and Organoleptic quality and Probiotic counts.

RESULTS AND DISCUSSION

Consumption and preparation techniques:

The study revealed that 73% of households of various ethnic groups including all South Indians, 83% of Bengalis, 69% of Marathis and Gujaratis, 100g or more of curd was consumed per day. Hence, a large number of Vadodara inhabitants may be getting an advantage of preventive aspects of probiotic bacteria. Cultural differences were noted in the choice for curd intake during illnesses like cold and cough, injuries, acidity, asthama and lactose intolerance. Most of the south Indians (80%), Marathis and Gujaratis (77%) and Bengalis (77%) avoided curd in cold and cough. Most of the north Indians (50%) and few Marathis and Gujaratis (39%) avoided curd during injuries. The effects of curd consumption during injuries, cold and cough has not been scientifically proved so far. Such cultural beliefs about cold and hot foods are so deep rooted in Indian families that many a times it deprives them of value added foods such as curd in their diet.

The curd preparation method in our study did not reveal that there was a significant difference in the source of milk and type of milk used for curd preparation and place of curd storage in between the curd preparatory methods at households and commercials (Table 1).

Traditionally, earthen wares were considered as ideal containers for curd preparation because of its moisture absorption capacity which results in good curd texture. However, the present study showed that most of the households (83 %) and commercials (79%) used steel containers. The families and the commercials that used mud pot for curd setting had noticeably good colour and consistency however there was no significant difference in the organoleptic qualities of curd set in different type of containers. The present study showed that the curd made in mudpot had significantly higher *S.thermophilus* counts which may be the reason for good texture. The place for setting the curd may make a difference in the quality of curd provided there is a difference in the temperature of these areas. The present study showed that most of the households and commercial outlets set curd in the open area of kitchen at ambient temperatures.

The washing technique preferred by the households and commercial outlets for utensils used for curd preparation showed a significant difference as 80% of the households and 28% of the commercials preferred detergents for washing utensils, repectively.

Organoleptic evaluation:

The results of organoleptic qualities revealed that organoleptic scores amongst the households were not significantly different but there was a significant difference in colour and consistency scores amongst the commercials (Table 1). Branded curd scored highest in organoleptic scores where as hostel scores were lowest. The higher organoleptic scores of branded curd could be due to noticeably higher counts for *Streptococcus thermophilus*, Lactobacilli and *Bifidobacteria* (Table 2) when compared to households and commercial outlets as it showed a good correlation between counts of *Streptococcus. thermophilus*, Lactobacilli and *Bifidobacteria* and colour and consistency (Table 5). Baisya and Bose (1975) also reported that *Streptococcus thermophilus* inoculated milk

Table 1 : Curd preparation techniques followed by households and commercials of urban Vadodara

Categories	Households (N = 30) N (%)	Commercials (N = 28) N (%)	Chi square
Source of milk			
Dairy milk	28(93)	2(7)	11.94***
Milk from local vendor	15(54)	13(46)	
Type of milk			5.087*
Skimmed milk	4(13)	26(87)	
Whole milk	11(39)	17(61)	
Type of starter			
Starter from market curd	4(13)	26(87)	0.1500^{NS}
Starter from homemade curd	11(39)	17(61)	
Age of starter			
Fresh	2(20)	26(80)	2.815^{NS}
1 day old	6(21)	22(79)	
Area of curd setting			
Open area of kitchen	26(83)	6(17)	1.2826^{NS}
Cupboard	21(75)	7(25)	
Place of storage			
Room temperature	2(6.67)	28(98.33)	6.1162*
Refrigerator	9(32)	19(68)	
Washing utensils			
Plain water rinsing	6(20)	17(60.71)	10.032**
Using detergents	24(80)	11(39.28)	

NS – Non significant
*, ** and *** indicates significance of values at P=0.05, 0.01 and 0.001, respectively

Table 2 : Probiotic counts observed in the curd made by various households and commercials of urban Vadodara

Categories	*Bifidobacteria* Log_{10}CFU/ml mean	*S.thermophilus* Log_{10}CFU/ml mean	Lactobacilli Log_{10}CFU/ml mean
Ethnic groups			
Marathis and Gujaratis	8.574	10.901	10.945
North Indians	8.562	10.906	10.948
South Indians	8.627	10.904	10.894
Bengalis	8.690	10.886	10.906
F test	0.963^{NS}	0.083^{NS}	0.911^{NS}
Commercial outlets			
Branded dairies	8.7629^{abc}	10.973	10.902
Local dairies	8.5961^{ad}	10.903	10.842
Restaurants	8.586^{b}	10.821	10.840
Hostels	8.4713^{cd}	10.841	10.812
F test	4.837^{***}	1.148^{NS}	0.953^{NS}

NS – Non significant Similar alphabets show significant difference
*** indicates significance of value at P=0.001

Table 3: Lactobacilli present in the curd samples of various households, branded and commercials of urban Vadodara

Curd samples	Lactobacilli
BIS Classification	*L. bulgaricus, L. acidophilus, L. casei, S. thermophilus*
Branded	*L. delbreukii, L. lactis, L. bulgaricus, L. acidophilus, L.fermentum, L. cellobiosis, L. plantarum, L. casei, S. thermophilus, Bifidobacteria*
Commercial outlets	*L. delbreukii, L. lactis, L. bulgaricus, L. acidophilus, L.fermentum, L. cellobiosis, L. plantarum, L. casei, L.curvatus, L.brevis, S. thermophilus, Bifidobacteria*
Households	*L. delbreukii, L. lactis, L. bulgaricus, L. acidophilus, L.fermentum, L. cellobiosis, L. plantarum, L. casei, L.curvatus, L.brevis, S. thermophilus, Bifidobacteria*

Table 4 : Pathogen counts observed in the curd made by various households and commercials of urban Vadodara

Categories	*Salmonella* Mean ± SD	*Shigella* Mean ± SD	*E.coli* Mean ± SD
Households (n=20)			
Mean ± SD	0	.067 ± 0.75	3.85 ± 3.03
Range	0	0 - 2	0 -9
Commercials (n=20)			
Mean ± SD	0	1.30 ±1.66	5.26 ± 6.37
Range	0	0 - 5	0 - 23
t value	0	1.681 NS	1.343 NS

NS – non significant

yielded curd of superior texture The present study also showed a good correlation between counts of *S. thermophilus,* Lactobacilli and *Bifidobacteria* and colour and consistency (Table 5).

Table 5 : Correlation of different probiotic counts with organoleptic parameters, pH and amount of starter

r value	*Bifidobacteria*	*S. thermophilus*	*Lactobacilli*
pH	0.152	0.2448	0.1736
Colour	0.463	0.529	0.312
Consistency	0.510	0.559	0.283
Flavour	0.068	0.240	0.076
Absence of defects	0.056	0.055	0.149
Overall organoleptic quality	0.152	0.244	0.173
Amount of starter	-0.01	0.191	-0.09
E.coli	-0.214	-0.06	-0.159

Microbiological analysis*:*

As shown in Table 2, the present study showed nearly equal proportion of *S.thermophilus* and Lactobacilli counts in the curd samples of households and commercials. The counts of *Streptococcus thermophilus* and Lactobacilli obtained were in the range of $5.1 \times 10^{10} - 1.2 \times 10^{11}$CFU/ml and $5.2 \times 10^{10} - 1.2 \times 10^{11}$ CFU/ml, respectively and *Bifidobacteria* counts ranged from $2x10^8 - 7.5x10^8$ CFU/ml. Shah (2000) suggested a minimum viable number of 10^8cfu/ml to compensate for reduction through passage of gut and bring about beneficial effect in gut. The curd samples of households and commercials were probiotic in nature.

In the present study the Lactobacilli species recommended by BIS such as *L. bulgaricus, L. acidophilus, L. casei* and *S. thermophilus* were present in all the curd samples in households and commercial settings. In addition, *L. delbreukii, L. lactis, L. fermentum, L. cellobiosis L. brevis* and *L. curvatus* were also detected in the curd samples analyzed (Table 3). Since *L. brevis* and *L. curvatus* which were absent in the branded curd samples and present in all households and other commercial outlets, they may be responsible for low scores of flavour and texture of curd. Jamal and Haddadin (2005) have also reported *L. brevis* for poor organoleptic quality of curd that included friable and flaky texture and taste defects.

As shown in Table 4, the study indicated absence of *Salmonella*, few *Shigella* and *E. coli* in curd samples of households and commercial outlets of urban Vadodara.

Literature has reported inability of *Salmonella* to survive at low pH. Nassib *et al.* (2006) also reported that *Salmonella* was less able to survive in mixed cultures of *S. thermophilus* and *L. bulgaricus.*

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