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Effect of different coagulants on chemical quality of paneer

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Abstract

India is the largest milk producing country in the world with 198.4 million tones milk production and per capital availability 406 gms/day (2019-20). There is scope for expanding and improving the indigenous confections by introducing a variety of products adopting improved methods and technology. Paneer is Heat-acid Coagulated and an important indigenous milk product, which is extensively used as base material or filler in preparation of large number of culinary dishes. Paneer is good source of animal protein to the vegetarian food. Present Study was undertaken with Effect of different coagulant i.e Citric acid (2%), Lactic acid (2%), Tartaric acid (2%) and Lemon juice (Fresh as such) on Chemical Quality of paneer prepared using Buffalo and Cow milk. The different chemical properties and sensory quality are determined. Present investigation, it may be concluded that lactic acid could be successfully utilized for preparation of paneer. The most acceptable quality paneer can be prepared from buffalo milk by using lactic acid as coagulant (T2C2) then It contained average 27.28, 49.18, 1.96 0.71 and 17.24 percent fat, total solid, ash, acidity and protein respectively. Utilization of lactic acid in paneer preparation improved sensory quality and acceptability of the product.

Keywords: Cow milk, coagulants, whey, paneer, sensory etc.

Introduction

India is the largest milk producing country in the world with 198.4 million tones milk production and per capital availability 406 gms/day (2019-20) (NDDDB Website). Pattern of milk utilization in India indicates that about 37.7% of total milk produced in India is converted in various milk products which occupies prominent place in Indian economy (Sahu, 2007) [26]. Chhana heat acid coagulated product of the milk forms the base material for manufacturing Paneer. Pattern of milk production in India indicates that about 6 percent of the milk produced is coagulated to produce chhana (Sahu and Das, 2007) [26]. Paneer is an important indigenous milk product, which is extensively used as base material or filler in preparation of large number of culinary dishes. Paneer production in India is about 2,35,000 tones which amounts to Rs. 18 billion (Kantha and Kanawjia, 2007) [16]. This indicates that there is tremendous opportunity for manufacture and marketing of paneer. According to PFA act (1976) paneer means the product obtained from cow or buffalo milk or combination thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70 percent moisture and the milk fat content shall not be less than 50 percent of the dry matter. Paneer is an Indian variety of soft cheese characterized by typical mild acidic flavour with slightly sweet taste, spongy body and close-knit texture. It is a rich source of protein and fat. It contains 53-55% moisture, 23-26% fat, 17-18% protein, 2-2.5% carbohydrates and 1.5 to 2.0% minerals (Kanawjia *et al.* 1990) [15]. The quality of paneer prepared depends upon the type and quality of milk used, heat treatment of milk, type, strength and amount of coagulant used, coagulation temperature and pH of coagulation (Rao *et al.* 1992) [20]. Paneer is mainly used as base material in the preparation of various culinary dishes like curries of peas, potatoes, spinach etc. Paneer snacks are close competitors of those made out of fried fish or chicken in terms of popularity. Paneer is good source of animal protein to the vegetarian food. It is an excellent match of non-vegetarian food. The present study entitled "Effect of different coagulants on Chemical Quality of paneer was undertaken with following objectives:

1. To standardize the procedure for manufacturing paneer by using different coagulants.
2. To find out suitable coagulant for preparation of paneer.
3. To find out effect of different coagulant on Chemical Quality of paneer
4. To find out most acceptable Treatment

Material and Methods Material

The present work was carried out at the Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli (DR. BSKKV DAPOLI)- 415 712 Dist. Ratnagiri (Maharashtra)

Raw milk: Bulk raw milk from the herd of crossbred cows and buffalos maintained at dairy unit of College of Agriculture, Dapoli was used for the study.

Coagulants: For the coagulation of milk during paneer preparations following coagulants were used: 1) Citric acid 2) Lactic acid 3) Tartaric acid 4) Lemon juice

Equipment's and Accessories: Aluminum and stainless-steels vessels., Karahi. Ladle, Muslin cloth, Paneer hoop, Standard weight.

Methodology

Preparation of Paneer

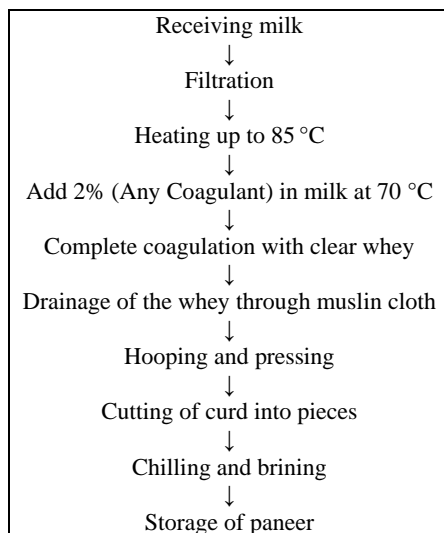


Fig 1: Paneer was prepared as per the procedure standardized by Battacharya *et al.* (1975) ^[1] with slight modifications.

Treatments

Type of milk: T1- Cow milk, T2- Buffalo milk

Type of coagulants: C1-Citric acid (2%), C2- Lactic acid (2%) C3-Tartaric acid (2%) C4-Lemon juice (Fresh as such)

Treatment combinations

T1C1- Cow milk/Citric acid;
 T1C2- Cow milk/Lactic acid;
 T1C3- Cow milk/Tartaric acid;
 T1C4- Cow milk/Lemon juice;
 T2C1- Buffalo milk/Citric acid;
 T2C2- Buffalo milk/Lactic acid;
 T2C3- Buffalo milk/Tartaric acid;
 T2C4- Buffalo milk/Lemon juice

Replications: The trial was conducted with six replications.

Analytical Methods

Milk

Total Solids

The total solids were determined by gravimetric method as per IS:1479 (part II), 1961 ^[11]

Fat

The fat content was determined by using Gerber method as described in IS: 1224 (Part-I), 1977 ^[9]

Protein

The protein content was determined by estimating the percent Nitrogen by Micro-Kjeldhal's method. The percent Nitrogen was then multiplied by 6.38 to find out the protein percentage of milk.

Titrateable Acidity

The acidity of milk expressed as percent lactic acid was determined according to IS: 1479 (Part-I), 1960 ^[10].

Paneer

Total Solids

The total solids were determined by Gravimetric method as described in IS: 1479 (Part-II), 1961 ^[11].

Fat

The fat content was determined by the Gerber method as per the procedure described by Chaudhari, (1959) ^[5].

Protein

The protein content was determined by estimating the percent Nitrogen by Micro-Kjeldhal's method. The percent Nitrogen was then multiplied by 6.38 to find out the protein percentage of paneer.

Ash

Ash content was determined by the method described in A.O.A.C., 1975 ^[1].

Titrateable Acidity

Titrateable acidity was determined as per procedure given by Chaudhari (1959) ^[5]

Statistical Design and Analysis

The statistical design adopted to study the different aspects was Factorial Randomized Block Design with six replications and eight treatment combinations. The statistical analysis was carried out according to Snedecor and Cochran (1994) ^[27]. The sensory score of paneer was compared statistically to test the significance of difference by Friedman's test of concordance as described in IS: 6273 (Part-III), 1983 ^[13]. The mathematical model used is as under:-

$$T = 12 \frac{n}{mn(n+1)} \sum_{i=1}^m Ri - 3m(n+1)$$

m= number of panelists

n= number of samples

Ri= sum of ranks for ith sample

Results and Discussion

The present investigation was undertaken to evaluate chemical quality of Paneer by using different Coagulants and type of milk. The results of present research work are average of six-time replicated data tabulated, presented and discussed along with Statistical analysis under following main heads.

Chemical quality of milk

Average chemical composition of fresh milk of cow and buffalo used for the preparation of paneer is depicted in Table 1.

Table 1: Average chemical composition of fresh milk of cow and buffalo used for the preparation of paneer is depicted

Type of milk	Chemical Parameter					
	Total solids	Fat	Protein	Ash	Titratable acidity	Solids not fat
Cow milk	12.84	4.12	3.38	0.72	0.13	8.72
Buffalo milk	15.46	6.35	3.82	0.83	0.15	9.11

The observations in the Table 1. indicate that the average chemical composition of buffalo and cow milk lie within the limits of legal standards for buffalo and cow milk in Maharashtra state as prescribed by PFA rules, 1976 cited by De (2008) [6].

Chemical properties of Paneer

Chemical properties in paneer prepared from types of milk by using different coagulants are presented in Table 2. Subjected to the chemical evaluation as below:

Table 2: Effect of different coagulants on Chemical Quality of paneer

Treatments Combination	Chemical Parameter					
	Fat	Total solids	Ash	Titratable Acidity	Protein	
T ₁ C ₁	24.85	45.24	1.95	0.61	16.90	
T ₁ C ₂	24.35	45.61	1.88	0.63	16.85	
T ₁ C ₃	23.06	43.19	1.89	0.68	16.95	
T ₁ C ₄	23.54	44.83	1.82	0.72	16.80	
Average(T1)	23.95	44.71	1.88	0.66	16.87	
T ₂ C ₁	26.75	48.86	2.01	0.70	17.27	
T ₂ C ₂	27.28	49.18	1.96	0.71	17.24	
T ₂ C ₃	25.56	47.03	1.99	0.74	17.13	
T ₂ C ₄	26.87	48.73	1.81	0.78	17.11	
Average(T2)	26.61	48.45	1.94	0.73	17.19	
Mean	25.28	46.58	1.91	0.69	17.02	
SEm±	Milk	0.0083	0.6452	0.0253	0.0230	0.0216
	Coagulant	0.0118	0.9125	0.0357	0.0325	0.0305
	Interaction	0.0027	0.2150	0.0084	0.0076	0.0072
CD (P=0.05)	Milk	0.0239	1.8525	0.0726	0.0661	0.0620
	Coagulant	0.0338	2.6198	0.1027	0.0935	0.0878
	Interaction	0.0079	0.6175	0.0242	0.0220	0.0206

Total Solids

Total solids content of paneer varied significantly due to types of milk with the average values of 44.71 and 48.45 percent for cow and buffalo milk, respectively.

Total solids content of 45.24, 45.61 and 44.83 percent were observed in paneer prepared by Cow milk (T₁ using citric acid, lactic acid and lemon juice, respectively and Total solids content of 48.86, 49.18 and 48.73 percent were observed in paneer prepared by Buffalo milk (T₂) using citric acid, lactic acid and lemon juice, respectively Significantly lower total solids content was recorded in paneer prepared by using tartaric acid as coagulant (43.19 (T₁) and 47.03 (T₂) percent). The average values for total solids content in paneer are more or less similar to the figures reported by Boghra and Mathur (1995) [3], Pal and Agnihotri (1995) [18], Pal *et al.* (1999) [17]. They reported 49.15 percent total solids for buffalo milk paneer, 42.22 to 51.80 percent for goat milk paneer and 48.67 percent for buffalo milk, respectively. Pal *et al.* (1999) [17] reported 44.90 percent total solids for paneer prepared from standardized buffalo milk by using citric acid as coagulant.

Sachdeva and Singh (1987) [21] recorded 55.74, 55.47 and 54.99 percent moisture content of paneer i.e., 44.26, 44.83 and 45.01 percent total solids by using citric, tartaric and lactic acid, respectively from standardized buffalo milk.

Fat:

The higher fat percentage was noticed in paneer prepared from buffalo milk (26.61 percent) and lowest in cow milk (23.95 percent).

Among the coagulants used for paneer prepared by Cow milk (T₁) fat percentage of 24.85, 24.35 and 23.54 percent, using citric acid, lactic acid and lemon juice, respectively and fat

content 26.75, 27.28, and 26.87 percent were observed in paneer prepared by Buffalo milk (T₂) using citric acid, lactic acid and lemon juice, respectively Significantly lower Fat content was recorded in paneer prepared by using tartaric acid as coagulant 23.06 (T₁) and 25.56 (T₂) percent).

Showed the respectively which were at par with each other. The lowest value of 23.06 percent fat was found in paneer prepared by using tartaric acid as coagulant.

The results corroborate well with values reported by Adhao (1990) [2] and Salunkhe (2007) [24]. Adhao (1990) [2] stated that paneer from buffalo milk contained on an average 25.65 percent fat, whereas Salunkhe (2007) [24] observed that paneer prepared from 100 percent buffalo milk contained 26.10 percent fat.

De (2008) [6] stated that according to PFA rules, 1976 milk fat content of chhana or paneer should not be less than 50.00 percent of dry matter. The average values from Table indicates that the paneer prepared in present investigation confirmed to these legal standards.

Protein

The lowest protein content was recorded in paneer prepared from cow milk T₁ (16.87 percent) whereas treatment T₂ (buffalo milk) showed the highest protein (17.19 percent) content.

The average values of protein content at different coagulants viz; citric acid, lactic acid, tartaric acid and lemon juice were 16.90, 16.85, 16.95 and 17.80 percent, respectively prepared by using Cow milk (T₁) and 17.27, 17.24, 17.13 and 17.11 respectively prepared by using buffalo milk(T₂). The variation in the values was significant ($p < 0.05$)

Sachdeva *et al.* (1991) [23] and Sayed *et al.* (1992) [25] reported

18.50 and 18.43 percent protein of paneer prepared from cow milk with 4.4 percent fat and, 4.5 fat and 8.5 percent SNF, respectively.

Ash

There was significant variation in ash content of paneer due to types of milk and coagulant. The lowest ash content (1.88 percent) was observed in paneer made from cow milk (T1) whereas treatment (T2) buffalo milk shows average value of 1.94 percent for ash. The ash content of paneer made by using citric acid was found to be significantly higher (T1C1: 1.98 and T2C2:2.01 percent) as compared to paneer made with tartaric acid (T1C3: 1.89 and T2C3:1.99 percent), lactic acid (T1C2:1.88 and T2C2:1.96 percent) and lemon juice (T1C4:1.82 and T2C4: 1.81 percent). The results of present investigation are in close agreement with the values for ash content reported by several workers viz. Rajorhia *et al.* (1984)^[19], Sachdeva and Singh (1988)^[22], Dharam pal and Garg (1989)^[7] Sachdeva *et al.* (1991)^[23] who reported ash content of buffalo milk paneer as 1.87, 1.80 2.00 percent and 1.4 percent respectively.

Titrateable Acidity

The acidity content was observed to be significantly higher in

paneer prepared from buffalo milk (0.73 percent) than the cow milk (0.66 percent).

Maximum acidity was recorded in paneer prepared by using lemon juice as a coagulant (T1C4:0.72 and T2C4: 0.78 percent). The acidity percentage (T1C3: 0.68 and T2C3:0.74 percent), (T1C2:0.63 and T2C2:0.71 percent) (T1C1:0.61 and T2C1:0.70 percent) was noticed in paneer prepared by using tartaric acid, lactic acid and citric acid, respectively.

The variation in acidity content due to types of milk and coagulant was highly significant ($p<0.05$).

Sachdeva and Singh (1987)^[21] observed that paneer manufactured by using citric acid, tartaric acid and lactic acid possessed 1.28, 1.08 and 0.76 percent titrateable acidity, respectively.

Jadhavar *et al.* (2009)^[14] observed that paneer prepared from 100 percent cow milk possessed 0.61 percent acidity.

Sensory Analysis

The proximate analysis of paneer prepared by using different coagulant using cow and buffalo milk was carried out for general appearance, flavour, body and texture and overall acceptability. The results and statistical analysis are furnished in Table 3. The most acceptable paneer can be prepared from buffalo milk by using lactic acid as coagulant (T2C2).

Table 3: Effect of different Coagulant on Sensory Quality of Paneer

Treatments	Sensory Parameters (Using 9-point hedonic scale)							
	General appearance		Flavour		Body and Texture		Overall Acceptability	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
T1C1	6.90	7	6.76	7	6.85	6	6.83	7
T1C2	7.17	5	7.17	4	7.35	3	7.23	4
T1C3	7.04	6	7.02	6	6.96	5	7.00	6
T1C4	6.90	7	6.72	8	6.74	7	6.78	8
T2C1	7.63	2	7.50	2	7.46	2	7.53	2
T2C2	7.66	1	7.55	1	7.50	1	7.58	1
T2C3	7.56	3	7.43	3	7.35	3	7.43	3
T2C4	7.23	4	7.11	5	7.18	4	7.17	5
T Cal =	13.32		12.72		15.00		18.60	
TableValu = ($p<0.05$)	14.07		4.07		14.07		14.07	

Conclusion

From the result of present investigation, it may be concluded that lactic acid could be successfully utilized for preparation of paneer. The most acceptable quality paneer can be prepared from buffalo milk by using lactic acid as coagulant (T2C2). It contained average 27.28, 49.18, 1.96 0.71 and 17.24 percent fat, total solid, ash, acidity and protein respectively. Addition of lactic acid in paneer improved sensory quality and acceptability of the product. Cow milk (T1) alone produced inferior quality paneer as compared to buffalo milk.

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