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Effect of Storage Period on Chemical, Organoleptic and Microbial Qualities of Paneer at Refrigeration Temperature

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ABSTRACT

Background: There is a demand for natural food preservatives as an alternative to artificial chemical compounds. Under refrigeration conditions, the paneer has a shelf life of 7-9 days. The application of preservatives can help to solve the problem of its short shelf-life. The present study was conducted to evaluate four types, S_0, S_1, S_2 and S_3 paneer samples. The effect of storage period on paneer, control and treated with brine (10% w/v), hydrogen peroxide (0.2%) plus lactic acid (0.75%) and paneer whey under refrigerated temperature (7±2°C) for 18 days was studied for the chemical, microbial and sensory qualities.

Methods: The samples were analyzed for milk fat, ash, titratable acidity (% LA), lactose, protein, soluble nitrogen, total solids, bacterial count, yeast and mould count as per the standard method. Paneer samples were organoleptically evaluated by a panel of 5 semi-trained judges. Results were analyzed using factorial randomized block design as described by Cochran and Cox.

Result: Among the different preservatives, treatments hydrogen peroxide plus lactic acid and brine were found to keep paneer acceptable for nearly 18 days at refrigerated storage. Based on the quality assessment of the product, hydrogen peroxide plus lactic acid treatment was superior and recommended.

Key words: Brine, Hydrogen peroxide, Lactic acid, Microbial quality, Organoleptic, Refrigerated temperature.

INTRODUCTION

Paneer, (an indigenous soft cheese product) is manufactured by the combined action of heat treatment and acid coagulation of buffalo or cow milk or a combination thereof. About 5% of the total milk produced in our country is converted to paneer mostly prepared in the unorganized sector of the dairy industry (Nayak and Bector, 1998).

Paneer contain approximately 17.5% protein, 25% fat, 2% lactose, 1.5% minerals and as high as 54% moisture (Singh *et al*.,1984). The relatively short life of paneer is a major handicap in the commercial adoption of paneer manufacturers. Its shelf life is reported to be only 6 days under refrigeration, though its freshness is lost within 3 days (Bhattacharya *et.al*., 1971; Sachdeva and Singh, 1995). Hence; an attempt was therefore made to develop a technology for improving the shelf life of paneer at refrigeration temperature. So, during the present investigation, efforts have been made to control the surface growth of microorganisms and chemical changes by treating paneer samples with different preservatives like brine, hydrogen peroxide plus lactic acid and paneer whey to extend the shelf life.

MATERIALS AND METHODS

The present study was conducted in the department of Animal Science and Dairy Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, India during M.Sc. dissertation work 1998-99. Paneer was prepared from Standardized (4% fat cow milk) described by Bhattacharya *et al*. (1971). Paneer samples were treated with chemical preservatives *viz.,* brine (10% w/v), hydrogen peroxide (0.2%) and lactic acid (0.75%) singly and in combination. Paneer whey which was obtained during the process of preparation was one of the treatments as a preservative. Treated samples were kept in polyethylene bags, sterilized in UV chamber for 5 min. in our laboratory. Four types of paneer samples, as given below, were stored at refrigeration temperature (7±2°C), as shown in Table 1.

The samples were analyzed for chemical composition, namely milk fat using the method as per IS: 1224 (part I), (1977), Sampling as per IS: 2785 (1964), Moisture as per IS: 10484 (1983), Ash as per IS: 5162 (1980), Fat as per IS: 10484 (1983), Titratable acidity (% LA) as per the method given in IS: 10484 (1983). Lactose was estimated as per IS: 1479 (part II), (1961). Protein was estimated semi-micro Kjeldahl method of Menefee and Overman (1940). Soluble nitrogen was estimated in the procedure presented for cheese and fermented milk foods by Kosikowski (1966). Total solids were calculated by subtracting moisture content in paneer from 100. Bacterial count as per IS: 5402 (1969),

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Yeast and mould count as per IS: 5403 (1969). Paneer samples were organoleptic ally evaluated by a panel of 5 semi-trained judges as per IS: 6273 (part II) (1971). Results were analyzed using factorial randomized block design as described by Cochran and Cox, 1957.

RESULTS AND DISCUSSION

Effects of storage period on moisture content in paneer at refrigeration temperature (7±2°C)

The moisture content in the fresh but treated samples was 54.45 (S_0) to 54.56 % (S_1). It was revealed that preservative treatments significantly affected the moisture content in the paneer (Table 2). Paneer samples treated with brine (S_1) contained more moisture, followed by S_3 and S_2. During the subsequent storage period, the moisture content in the paneer was reduced significantly ($p<0.5$) in almost all samples. It was indicative that the barrier of polyethylene bags might not be significant enough to check the moisture losses during storage. A significant difference was also observed in moisture content due to the preservative treatments. Similar observations were also recorded by Rao *et al.* (1984) and Bhosale (1989).

Effects of storage period on Acidity content in paneer at refrigeration temperature (7±2°C)

Significant variation was noticed in the acidity level on the day of samples treated with preservatives and subsequent period of storage. The reason might be variation in the level of moisture content resulted due to treatments given to samples and microbial activity during subsequent storage (Table 2) as the microbial activity has a direct relation with the level of acidity. It is revealed from the observations that treatment S_2 was more potent to check the activity of acid-producing microorganisms in paneer, as there was a slow increase in acidity. The rise in acidity was from 0.60% on the day of preparation to 0.78% on the 18th day of storage under refrigeration. Treatment S_1 stood second followed by S_3. On the 9th day of storage, the control samples become unacceptable with rising acidity from 0.615 to 1.035%. In general, when the samples became unacceptable the level of acidity was slightly more than 1%, except in S_2 treatment somewhat similar observations were made by Bhosale (1989). However, Rao *et al*. (1984) and Boghra *et al*. (1997) stated that there was no considerable rise in acidity of paneer during storage.

Effects of storage period on pH content in paneer at refrigeration temperature (7±2°C)

Significant variation was observed in the mean pH value of treated and control samples of paneer. However, the mean pH values among treated samples were on par. Similarly, significant variation in mean values was observed 3rd day onwards (Table 2). There was a considerable decrease in pH value (5.84) in the control sample on the 9th day. In general, there was a gradual decrease in pH values of the treated samples with the advancement of the storage period. However, the values observed when the product became unacceptable are comparable to those reported by Bhattacharya *et al*. (1971).

Effects of storage period on soluble nitrogen content in paneer at refrigeration temperature (7±2°C)

On the day of manufacture, paneer samples (control and treated) were estimated for soluble nitrogen was in the range of 0.091 to 0.099%, which differed significantly (Table 2). An increase in soluble nitrogen was faster in control (S_0) samples as the period of storage extended, followed by samples S_3, S_1 and S_2. It is assumed that the content of soluble nitrogen has some relation with microbial activities particularly proteolytic organisms. Slow production of soluble N in S_1 and S_2 samples during storage, might be due to some restriction caused by these preservatives on the growth of specifically proteolytic microorganisms, A more or less similar trend in the values of soluble nitrogen was noticed in their studies by Bhosle (1989) and Sachdeva and Singh (1990) which confirmed the findings of the present investigation.

Effects of storage period on Falvour of paneer at refrigeration temperature (7±2°C)

Fresh Paneer samples (treated and control) evaluated organoleptically indicated significant variation in numerical values. However, Judges allotted a maximum score (8.0) to sample S_3 followed by S_0 (7.80), S_2 (7.67) and S_1 (7.63) for flavour (Table 3). It seems that preservative treatments of chemicals given to paneer samples lowered their acceptability. On the contrary treatment of paneer samples with whey (S_3) enhanced its flavour securing 8.00 points higher than that of the control sample (7.80).

During the subsequent periods of storage, there was a continuous decline in flavour score till the day on which the particular sample became unacceptable. The difference in values of flavour score within the preservative treatments and period of storage was significantly inferior at each successive interval of evaluation.

Further, it was observed that paneer with preservative treatment S_2 and S_1 remained acceptable up to 18th days. Hydrogen peroxide and lactic acid might be more potent to restrict the growth of microorganisms responsible for off-flavour. The paneer samples S_0 and S_3 became unacceptable on the 9th and 12th day of storage due to off-flavour, putrefactive odour, developed acidity, bitter taste and slimy surface. Very similar observations were made in their studies by Kumar and Bector (1991) and Munjal and Bector (1996).

Table 1: Paneer samples stored at refrigerated temperature.

Samples	Treatment	Dipping time
S_0	Control	-
S_1	Brine (10% w/v)	30 min.
S_2	Hydrogen peroxide (0.2 %) 1st dip.	10 min
	+ Lactic acid (0.75%) 2nd dip	10 min.
S_3	Paneer whey	30 min.

Table 2: Effects of storage period on Chemical attributes of paneer at refrigeration temperature (7±2°C).

Treatment	Storage period (days)							Source	SE±	CD (0.05)
	0	3	6	9	12	15	18			
					Moisture %					
S_0	54.45	53.89	53.39	53.03	-	-	-	Treatment	0.021	0.06
S_1	54.56	54.02	53.56	53.15	52.90	52.64	52.48	Days	0.021	0.06
S_2	54.47	53.91	53.49	53.12	52.84	52.61	52.44	Treatment × Days	0.042	NS
S_3	54.51	53.93	53.45	53.09	52.80	-	-		-	-
					Titratable acidity (% LA)					
S_0	0.615	0.675	0.810	1.035	-	-	-	Treatment	0.013	0.038
S_1	0.585	0.630	0.690	0.765	0.855	0.945	1.080	Days	0.013	0.038
S_2	0.600	0.615	0.630	0.660	0.690	0.705	0.780	Treatment × Days	0.026	0.076
S_3	0.570	0.645	0.735	0.840	1.035	-	-		-	-
					pH					
S_0	6.11	6.08	6.00	5.84	-	-	-	Treatment	0.009	0.026
S_1	6.15	6.13	6.09	6.05	6.00	5.94	5.79	Days	0.009	0.026
S_2	6.13	6.12	6.11	6.11	6.09	6.07	5.99	Treatment × Days	0.018	0.053
S_3	6.18	6.14	6.08	6.01	5.85	-	-		-	-
					Soluble nitrogen %					
S_0	0.099	0.134	0.213	0.280	-	-	-	Treatment	0.001	0.004
S_1	0.094	0.098	0.126	0.164	0.220	0.263	0.288	Days	0.001	0.004
S_2	0.091	0.094	0.102	0.112	0.142	0.185	0.219	Treatment × Days	0.003	0.007
S_3	0.097	0.125	0.173	0.245	0.291	-	-		-	

Table 3: Effects of storage period on Organoleptic attributes of paneer at refrigeration temperature (7±2°C).

Treatment	Storage period(days)							Source	SE±	CD (0.05)
	0	3	6	9	12	15	18			
					Flavour					
S_0	7.80	7.50	6.73	5.73	-	-	-	Treatment	0.037	0.106
S_1	7.63	7.40	7.17	6.87	6.60	6.27	5.53	Days	0.037	0.106
S_2	7.67	7.43	7.20	6.87	6.53	6.37	5.73	Treatment × Days	0.073	0.211
S_3	8.00	7.80	7.47	6.83	5.63	-	-		-	-
					Body and Texture					
S_0	8.27	8.13	7.83	7.57	-	-	-	Treatment	0.019	0.055
S_1	8.07	7.83	8.67	7.50	7.70	7.73	7.63	Days	0.019	0.055
S_2	8.17	8.07	7.93	7.83	7.67	7.43	7.27	Treatment × Days	0.038	0.111
S_3	8.13	8.03	7.87	7.73	7.30	-	-		-	-
					Colour and appearance					
S_0	8.10	7.73	6.97	5.93	-	-	-	Treatment	0.034	0.099
S_1	7.90	7.67	7.47	7.27	6.93	6.50	5.97	Days	0.034	0.099
S_2	8.10	7.80	7.47	7.13	6.83	6.37	5.83	Treatment × Days	0.069	0.198
S_3	8.00	7.70	7.30	6.73	5.87	-	-		-	-

Effects of storage period on Body and texture of paneer at refrigeration temperature (7±2°C)

The critical review showed that preservative treatments given to paneer did not influence the body and texture attribute (Table 3). However, control sample S_0 remained superior over others *i.e.* S_1, S_2 and S_3. Absorption of water during the process of dipping might result in sponginess. There was the continuous decline of allotment of scores by the judges in almost all stored, samples, till the product became unacceptable. Somehow there was an improvement in body and texture in the case of brine treated samples (S_1) after the 9th day of storage as seen from the numerical values. There was a decrease in stickiness.

In no case, the paneer samples were rejected based on undesirable body and texture. Though it became unacceptable based on flavour. In support of this, Sachdeva and Singh (1990) observed that the body and texture score of the untreated paneer sample varied over a narrow range of 7.0 to 7.6 on zero-day and 6.5 to 7.0 at the end of storage.

Table 4: Effects of storage period on microbial attributes of paneer at refrigeration temperature (7±2°C).

Treatment	Storage period (days)							Source	SE±	CD (0.05)
	0	3	6	9	12	15	18			
					Standard plate count (cfu/g)					
S_0	38.64 $\times 10^3$	76.03 $\times 10^3$	44.77 $\times 10^4$	25.29 $\times 10^6$	-	-	-	Treatment	0.012	0.034
S_1	35.48 $\times 10^3$	44.36 $\times 10^3$	65.16 $\times 10^3$	91.83 $\times 10^3$	12.42 $\times 10^4$	36.04 $\times 10^4$	67.28 $\times 10^5$	Days	0.012	0.034
S_2	46.34 $\times 10^2$	57.68 $\times 10^2$	79.43 $\times 10^2$	91.62 $\times 10^2$	17.50 $\times 10^3$	76.27 $\times 10^3$	40.99 $\times 10^4$	Treatment × Days	0.024	0.069
S_3	37.84× 10^3	61.80 $\times 10^3$	92.90 $\times 10^3$	31.99 $\times 10^4$	11.74 $\times 10^6$	-	-		-	-
					Yeast and mould count					
S_0	36.97 $\times 10$	10.02 $\times 10^2$	89.33 $\times 10^2$	34.51 $\times 10^4$	-	-	-	Treatment × Days	0.044	0.127
S_1	31.05 $\times 10$	55.85 $\times 10$	76.91 $\times 10$	10.12 $\times 10^2$	30.33 $\times 10^2$	85.63 $\times 10^2$	40.42 $\times 10^3$		0.044	0.127
S_2	-	5.19	20.46	65.61	20.10 $\times 10$	27.80 $\times 10^2$	34.77 $\times 10^3$	Treatment Days	0.088	0.254
S_3	34.67 $\times 10$	89.74 $\times 10$	36.31 $\times 10^2$	17.99 $\times 10^3$	7.33 $\times 10^4$	-	-		-	-

Effects of storage period on Colour and appearance of paneer at refrigeration temperature (7±2°C)

The scores allotted by the judges (Table 3) revealed that on the day of treatment, almost all samples were quite attractive in colour and appearance. A lower score (7.90) for the S_1 sample might have been due to a slightly higher moisture level on the surface of the product. As the period of storage extended, the scores allotted for each sample declined. But no specific trend was noticed. However, the difference in the values of the score was found significant. The reasons for low scoring reported were yellowish tinge, coloured mouldy growth and development of coloured bacterial colonies.

In the present investigation, from the result, it was observed that paneer with preservative treatment S_2 and S_1remain acceptable up to 18th days. But S_2 treatment was more effective in controlling the growth of microorganisms and thereby checking the chemical changes as compared to S_1. The paneer samples S_0 and S_3 became unacceptable on the 9th and 12th days of storage.

Effects of storage period on Standard plate count content in paneer at refrigeration temperature (7±2°C)

A comparatively lower count of treated samples was indicative of the fact that preservative treatments given to the paneer might have destroyed some of the micro organisms (Table 4). From the results, it is observed that treatment S_2 was the most potent against microorganisms present in the paneer samples, followed by S_1 and S_3.

No doubt, there was a continuous increase in the total population of microorganisms in almost all samples throughout storage even under cold conditions. However, preservatives could extend the shelf life of the product as seen in this study. There is no specific standard mentioned for microorganisms in the paneer to decide its acceptance / rejection. In this study, paneer samples became unacceptable when SPC was more than 10 lakhs/g. A more or less similar trend in the microbial count was observed in the past when Bhosale (1989) and Sachdeva and Singh (1990) carried out their studies on various aspects of paneer.

Effects of storage period on Yeast and mould count content in paneer at refrigeration temperature (7±2°C)

The presence of yeast and mould in fresh paneer samples (treated and control) revealed considerable contamination, with the exception of treatment S_2, which indicated that hydrogen peroxide with lactic acid eradicated all yeast and mould in paneer on the first day.. When compared to other treatments, such as S_0, S_1 and S_3, the yeast and mould count was also very low (Table 4). Congenial environment (developed acidity and sufficient moisture) in paneer samples might have favoured their growth during further storage. Usually, the yeast and mould count less than 100 could be acceptable in similar products; however, paneer stored for 3 days showed a count of more than 100 in all samples except in S_2 treated paneer. Thus, it could be revealed from the results that treatment S_2 only restricted yeast and mould growth in paneer to satisfactory level up to 9th days under refrigerated storage. A more or less similar trend in the microbial count was observed in the past when Sachdeva and Singh (1990) carried out studies on various aspects of paneer.

CONCLUSION

Treated paneer with hydrogen peroxide (0.2%) followed by lactic acid (0.75%) and stored under refrigerated conditions proved to be the best method for extending its shelf life (up

to 18 days). The next superior method was brine dipping. Dipping in paneer whey and refrigerated storage was another alternative to preserve paneer for up to 12 days. Wrapping in Polyethylene bags did not support extending the shelf life. However, its use will be beneficial to avoid contamination and easy handling of paneer. From an economic point of view the use of hydrogen peroxide followed by lactic acid treatment will be appreciated, while for small-scale producers, brine treatment will prove to be good. Since the small producers may not be offered hydrogen peroxide plus. lactic acid treatment.

Conflict of interst: None.

REFERENCES

Bhattacharya, D. C., Mathur, O. N., Srinivasan, M, R., Samlik, O. (1971). Studies on the method of production and shelf life of paneer (cooking type of acid coagulated cottage cheese). Journal of Food Science and Technol. 8: 117-120.

Bhosle, D. N. (1989).Studies on manufacture, packaging and preservation of paneer from mixed milk (cow and buffalo). Ph.D. A thesis submitted to the Mahatma Phule Krishi Vidyapeeth, Rahuri, India.

Boghra, V.K., Rajorhia, G.S., Mathur, O.N. (1997). Effect of exogenously added iron and copper on various chemical changes during storage of some selected indigenous milk products. Indian Journal of Dairy Science. 50:107.

Cochran, W. G. and Cox, G. M. (1957). Experimental Designs. 2nd Edn. John Wiley and Sons, Inc. New York.

IS: 1479. (Part II). (1961). Methods of Test for Dairy Industry Part II. Chemical Analysis of Milk. Indian Standards Institution, Manak Bhavan, New Delhi.

IS: 2785. (1964). Specification for Hard Cheese, Processed Cheese and Processed Cheese Spread. Indian Standards Institution, Manak Bhavan, New Delhi.

IS: 5402. (1969). Methods for Plate Count of Bacteria in Foodstuff. Indian Standards Institution, Manak Bhavan, New Delhi.

IS: 5403. (1969). Method for Yeast and Mould Count of Foodstuffs. Indian Standards Institution, Manak Bhavan, New Delhi.

IS: 6273. (Part II). (1971). Guide for sensory evaluation of food Part II. Methods and Evolution Cards. Indian Standards Institution, Manak Bhavan, New Delhi.

IS: 1224. (Part I). (1977). Methods for Determination of Fat by Gerber Method. Indian Standards Institution, Manak Bhavan, New Delhi.

IS: 5162. (1980). Specification for Chhana. Indian Standards Institution, Manak Bhavan, New Delhi.

IS: 10484. (1983). Specification for Paneer. Indian Standards Institution, Manak Bhavan, New Delhi.

Kosikowski, F. (1966). Cheese and Fermented Milk Foods. Edwards Brothers, Inc. Ann. Arbor. Michigan. pp. 350-352.

Kulkarni, S., Rajorhia, G.S., Chakraborty, B.K. (1984).Studies on shelf life of chhana. Indian Journal of Dairy Science. 37: 392-395.

Kumar, P. and Bector, B. S. (1991). Enhancement of shelf life of paneer with food additives. Indian Journal of Dairy Science. 44: 577-584.

Menefee, S G. and Overman O. R. (1940).A semi-micro Kjeldahl method for the determination of total nitrogen in milk. Journal of Dairy Science. 23(12): 1177-1185.

Modi, V.K. and Jain, S.C. (1985). Chemical Changes in Salted Dip Fat Fried Paneer on Storage. Fifth Convocation of Food Scientists and Technologists, New Delhi. Poster Session, abstract. 3: 05. Cited: Bhosle, 1989.

Munjal, S. and Bector, B. S. (1996). Effect of heat and coagulation on fat and glycerides of milk during manufacture and storage of paneer. Indian Journal of Dairy Science. 49: 448.

Nayak, S. K. and Bector, B. S. (1998). Chemical quality of paneer of Karnal and Delhi markets, Indian Jornal of Dairy Science. 51: 233-236.

Rao, M.N., Rao, B.V.R., Rao, T.J. (1984). Paneer from buffalo milk. Indian Journal of Dairy Science. 37: 50-53.

Sachdeva, S. and Singh, S. (1990). Shelf life of paneer as affected by antimicrobial agents. Part I- Effect on sensory characteristics. Indian Journal of Dairy Science.43: 60-70.

Sachdeva, S. and Singh, S. (1995). Industrial production of paneer innovation approaches. Indian Dairyman. 47: 11-14.

Singh, S., Kanawjia, S.K., Sachdeva, S. (1984). Current status and scope for future development in the industrial production of paneer. Indian Dairyman. 36: 581-585.