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Storage related changes in microbiological quality of filled milk paneer

N.K. SINGH[1] BAL RAM DWIVEDI[2] AND M.P. GUPTA[3]
Department of Animal Husbandry and Dairying, Brahma Nand Mahavidyalaya, Rath, Hamirpur-210431 (U.P.)

Abstract

Filled milk paneer, prepared by replacing milk fat with 5.0 percent vegetable oil (groundnut, mustard or sunflower refined oil) blended at 45^{0}C using one percent citric acid at 80^{0}C coagulation temperature, as well as milk paneer prepared from 5.0 percent buffalo milk were treated with different preservatives, viz. Sodium benzoate, potassium sorbate and BHA, packed with different packaging material and stored for varying periods at 5^{0}C were assessed for microbiological quality. Results revealed that the addition of preservatives retarded the growth of microorganisms during storage. Sodium benzoate was found to be the most effective preservative in controlling the total bliable count and proteolypic counts, while BHA was the most potent in retarding lipolytic organisms. Laminated aluminium foil packaging was the most effective packaging material in retarding all types of microorganisms in filled milk paneer during storage.

Key Words: Filled milk, vegetable oils, preservatives, microbiological quality

Introduction

According to the livestock census 2019, India possessed a livestock population of 535.82 million, out of which the bovine population was 302.82 million. In term of percentage, cattle constitute 35.93, buffalo 20.5, goats 27.70 and sheep 13.8 of the total livestock population. The average milk yield per day has increased to 8 Kg in buffaloes and 5 Kg in Indian cattle. The population of crossed cattle has increased by 27 percent in 2019 as against the previous live stock census of 2012 (Rajorhia, 2020)

Milk and milk products are essential commodities for meeting the nutritional requirements of human being. Milk serves as a daily source of income for the farmers and generates self employment for members of their families. Dairying supports women empowerment in rural areas. Animal Husbandry and dairy sector has immense potential in increasing farmers income and ensuring livelihood and food security in the country. Dairy sector is growing at a compound annual growth rate of eight percent during the last five years.

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.

Paneer has high nutritive value, as it contains almost all proteins and fat present in milk, besides being a rich source of minerals and vitamins. Due to high price and health consciousness, the consumers have started looking for an alternative to paneer. Low cost health promoting paneer can be made using skim milk added with vegetable oil. Such filled milk paneer made from skim milk blended with vegetable oils contain all milk solids except milk fat and processed in similar manner as milk paneer. Filled milk paneer is about one-third as costly as milk paneer (Singh *et al*., 2017, 2018) but a rich source of polyunsaturated fatty acids and

[1]Associate Professor, part of Ph. D. thesis.
[2]Assistant Professor, Department of Animal Husbandry and Dairying, Nehru P.G. College, Lalitpur (U.P.)
[3]Ex-Professor & Head, Pt. D.D. Upadhyay Veterinary University, Mathura, Present address: 26, Kailash Nagar, Tiwaripur, Kanpur-208010
email-mpgupta8@gmail.com

devoid of animal cholesterol, required for good health. The present paper reports data on the microbiological quality of filled milk paneer, as influenced by storage period for varying length of time to assess its shelf life.

Materials and Methods

Milk: Buffalo milk was procured from the college dairy and standardized to 5.0 percent fat and 9.0 percent MSNF using skim milk obtained by separation of cream from buffalo milk.

Selection of vegetable oils:

Three types of refined vegetable oil, namely groundnut, mustard and sunflower, were purchased from the standard shops.

Preparation of filled milk Paneer:

Filled milk paneer was prepared by replacing milk fat with 5.0 percent vegetable oils, using blending temperature of 45^0C at 80^0C coagulation temperature using one percent citric acid as coagulant according to Roy (1990) with certain modification. In each batch, ten litre of filled milk (containing 5.0 percent vegetable oil) was heated to 90^0 C (Roy and Singh, 1999). It was then coagulated with one percent citric acid, added slowly till clear whey separated out. The coagulated mass was pressed in a rectangular hoop lined with muslin cloth by applying pressure ($2Kg/cm^2$) and then dipped in chilled water for two hours, packaged and stored at 5^0C (Singh etal.,2017)

Milk paneer was made from buffalo milk (having five percent fat) according to Bhattachrya etal. (1971) with necessary modification (Sachdeva, 1983; Dwivedi etal., 2010)

1. Type of filled milk paneer (V)

V1- Control (milk paneer, 5% buffalo milk)

V2- Ground nut oil (5%)

V3- Mustard Oil (5%)

V4- Sunflower Oil (5%)

2. *Preservatives :* (0.05%) (A) :

A_1- Control, A_2- Sodium benzoate, A_3- Pot. sorbate, A_4- Butylate hydroxyl anisole (BHA)

3. *Packaging* (P):

P_1- Control (without packaging), P_2 plastic container, P_3- Glass bottle,

P_4- Polyethylene bags, P_5- Laminated aluminium foil.

4. Days of Storage (D) :

D_1- 0 day, D_2 – 5 day, D_3 – 10 day, D_4 – 15 day, D_5 – 20 day

Microbiological quality:

The samples of filled milk paneer, prepared using different vegetable oils, treated with different preservatives, packaged in various packaging materials and stored for different periods as detailed above at refrigeration temperature (5 to 7^0C) were assessed for changes in microbiological quality (total viable count, proteoltic, lipolytic and coliform counts) according to BIS (1962)

Results and Discussion

The objective of the study was to assess the microbiological quality of filled milk paneer treated with different preservatives and packaged with various packaging materials and stored for different periods at 5^0C. The changes in total viable count (cfu), proteolytic count, lipolytic count and coliform count were monitored as measure of bacteriological quality of the product.

1. Colony farming count (cfu)

The total viable count (cfu/g) in filled milk paneer (Table 1) were found to be $1.033x10^5$, $1.078x10^5$, $1.070x10^5$ and $1.084x10^5$, respectively, in different types of filled milk paneer (V_1, V_2, V_3 and V_4). The preservatives used had marked effect in reducing the cfu. Sodium benzoate (A_2) and pot. sorbate (A_3) were more effective them the BHA(A_4)

The packaging material, polyethylene bags (P_4) and laminated aluminium foil (P_5) were found to be more effective than P_2 and P_3 in controlling the cfu during storage. The cfu consistently increased as the storage period elapsed from zero to 20 days.

2. Proteolytic count

The data on changes in proteolytic count of filled paneer, presented in Table2, indicated that the average number of proteolytic count in different types of filled paneer in control (V_1), ground nut filled paneer (V_2), mustard oil filled paneer (V_3) and sunflower oil filled paneer (V_4), irrespective of preservatives, packaging and days of storage, were found to be $0.894x10^3$, $0.927x10^3$, $0.896x10^3$ and $0.901x10^3$, respectively. These values were highly significant, as revealed by the CD value. The preservatives elicited significant effect in controlling the proteolytic bacteria in filled milk paneer. Sodium benzoate (A_2) was found to be more potent in controlling the growth of proteolytic bacteria than the other two preservatives, namely pot. sorbate (A_3) and BHA (A_4).

Packaging materials also played role in diminishing the proteolytic count of filled paneer. Laminated aluminium foil (P_5) was more effective than the polyethylene (P_4), glass bottles (P_3) and plastic containers (P_2) in controlling the proteolytic bacteria

Table 1: Average Colony forming unit (perg) of filled paneer ($x10^5$) on account of various type of paneer (V), Preservatives (A), packaging(P) and days of storage (D)

Treatment		Mean
1. Types of filled Paneer(V)	V1	1.033 ±0.233
(irrespective of preservative, Packaging and day of storage)	V2	1.078 ±0.421
	V3	1.070 ±0.612
	V4	1.084 ±0.493
2. Preservative(A)	A1	1.264± 0.312
(irrespective of packaging types of filled paneer and day of storage)	A2	0.986±0.417
	A3	1.002±0.291
	A4	1.013±0.418
3. Packaging (P)	P1	1.213±0.294
(Irrespective of types of filled paneer, preservative and day of storage)	P2	1.081±0.324
	P3	1.062±0.671
	P4	0.997±0.373
	P5	0.994±0.307
4. Day of storage (D)	D1	0.498±0.391
(Irrespective of types of filled paneer, preservative and day of storage)	D2	0.665±0.412
	D3	0.786±0.711
	D4	1.521±0.567
	D5	1.860±0.872
CD: V 0.006, A 0.006, P. 0.007, D 0.007		

Table 2: Average proteolytic count of filled paneer /g. ($x10^3$) on account of various type of paneer(V), preservatives (A), packaging(P) and days of storage (D)

Treatment		Mean ($x10^5$)
1. Types of filled Paneer(V)	V1	0.894±0.323
(irrespective of preservative, Packaging and day of storage)	V2	0.927±0.216
	V3	0.896±0.349
	V4	0.901±0.231
2. Preservative(A)	A1	0.943±0.714
(irrespective of packaging types of filled paneer and day of storage)	A2	0.880±0.219
	A3	0.897±0.481
	A4	0.899±0.423
3. Packaging (P)	P1	0.970±0.761
(Irrespective of types of filled paneer, preservative and day of storage)	P2	0.916±0.423
	P3	0.902±0.341
	P4	0.877±0.231
	P5	0.837±0.234
4. Day of storage (D)	D1	0.317±0.319
(Irrespective of types of filled paneer, preservative and day of storage)	D2	0.444±0.214
	D3	0.689±0.512
	D4	1.400±0.726
	D5	1.674±0.728
CD: V 0.0056, A 0.0056, P. 0.0062, D 0.0062		

during storage. Polyethylene packaging (P_4) was found to be better than glass bottles or plastic containers in controlling proteolytic count during storage. The effect of period of storage (D) had highly significant effect on the increase of proteolytic count, as the period of storage progressed. The proteolytic count consistently increased as the period of storage due to the growth of proteolytic bacteria in the product.

Table 3: Average lipolytic count of filled paneer /g. ($x10^4$) on account of various type of paneer(V), preservatives(A), packaging(P) and days of storage (D)

Treatment		Mean ($x10^4$)
1. Types of filled Paneer(V)	V1	1.751±0.493
(irrespective of preservative, Packaging and day of storage)	V2	1.758±0.324
	V3	1.762±0.192
	V4	1.768±0.290
2. Preservative(A)	A1	1.899±0.513
(irrespective of packaging types of filled paneer and day of storage)	A2	1.707±0.329
	A3	1.732±0.421
	A4	1.700±0.323
3. Packaging (P)	P1	1.865±0.612
(Irrespective of types of filled paneer, preservative and day of storage)	P2	1.784±0.531
	P3	1.734±0.341
	P4	1.714±0.232
	P5	1.702±0.432
4. Day of storage (D)	D1	0.769±0.229
(Irrespective of types of filled paneer, preservative and day of storage)	D2	0.945±0.342
	D3	1.614±0.541
	D4	2.050±0.613
	D5	3.421±0.538
CD: V 0.0135, A 0.0135, P 0.0151, D 0.0151		

Lipolytic count:

The average lipolytic count (cfu/g) of filled milk paneer (Table 3) were found to be $1.75x10^4$, $1.76x10^4$, $1.76x10^4$ and $1.77x10^4$, respectively in different types of filled paneer (V_1, V_2, V_3 and V_4). Use of different preservatives in filled paneer retarded the growth of lipolytic bacteria during storage of the product. Butylated hydroxyanisole (A4) was found to be the most effective in diminishing the lipolytic count during storage, followed by the sodium benzoate (A_2) and pot. sorbate (A_3). The type of packaging material used also had significant effect in controlling the growth of lipolytic organisms during storage. Laminated aluminium foil (P_s) was found to be the most effective followed by the polythene bags (P_4). Glass bottles (P_3) were found to be more effective than plastic containers (P_2). The period of storage and significant effect on the increase in lipolytic count. With advancement in the storage period, the lipolytic organism proliferated. Upon 10 days of storage (D_3), the average lipolytic count was $1.61x10^4$, thereafter it increased at a very high pace.

The interaction effect due to Px DxV, AxPxV, AxPxD and AxPxDxV combinations indicated that the minimum lipolytic count in filled paneer was observed to be in A4 or/and P_5, which revealed that BHA (A_4) and packaging with the laminated aluminium foil (P_5) gave maximum protection against the growth of lipolytic bacteria during storage.

Coliform count:

The coliform organisms were not observed either the fresh product or the product stored for different periods during storage. The reason is attributed to the strict sanitary measures adopted during the production and storage of the filled milk paneer.

There is paucity of published data on either microbiological quality of filled milk paneer or changes in storage related microbiological quality of the product, whereas adequate literature is available on similar aspect of paneer. The fresh samples prepared under hygienic conditions contained only few organisms but they proliferated with increase in the storage period. The addition of preservatives retarded, the growth of microorganisms during storage, as indicated by the decreased total viable count and proteolytic and lipolytic counts. Sodium benzoate was found to be the most effective preservative in controlling the total viable count and proteolytic counts, while BHA (Butylated hydroxyl anisole) was observed to be the most potent in retarding the lipolytic organisms. Laminated aluminium foil packaging was the most effective

packaging material in retarding all types of microorganisms in the filled milk paneer during storage.

The study further revealed that the total viable count and proteolytic and lipolytic counts increased at slower place upto 10 days storage period, thereafter in increased with a faster rate. Such findings are closely related with the general acceptability of the product on a 9- point hedonic scale, as observed in our previous study on filled milk paneer (Singh etal, 2018). Based on the data on storage related changed in microbiological quality of the product and its acceptability scores, it was inferred that the product could be stored with good acceptability scores, 10 days of storage at 5^0C. The results also affirmed that acceptable quality of filled milk paneer could be prepared by replacing milk fat with either ground not, mustared or sunflower oil at five percent level of fat (Singh etal., 2017)

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