

Impact of Edible Coating and Different Packaging Treatments on Microbial Quality of Paneer

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Abstract

The effects of edible coating and different packaging treatments on microbial quality of paneer were studied. Composite edible coated paneer was packed in packaging materials and stored under different storage conditions 5°C (T₁), 30°C (T₂) and ambient conditions (T₃). Packaging material had significant effect ($P \leq 0.05$), coating and temperature and their interactive effect were found significant ($P \leq 0.01$) on total viable count of the product during storage. At 5 ± 1°C, uncoated samples of paneer packed in laminates (P₄) had total viable count 1.08 × 10⁴ cfu/g on 28th day of storage while coated paneer sample packed in LDPE (P₆) and laminates (P₇) had maximum shelf life i.e. 40 days with 1.6 × 10³ and 2.75 × 10³ cfu/g total viable count. Coating of paneer, packaging material and temperature and their interactive effect were found significant ($P \leq 0.01$) on Yeast & Mould count of the product during storage. Uncoated samples of paneer packed in laminates had Y & M counts 6.0 × 10³ cfu/g on 28th day of storage, whereas LDPE and laminates packed coated paneer had Y & M counts 3.4 × 10³ and 2.15 × 10³ cfu/g on 40th day of storage 5 ± 1°C.

Keywords: Edible coating; Paneer; Quality; Packaging material; Shelf life

Introduction

Milk and milk products form an essential component of the human diet and no other single natural food meets the nutritional requirements better than milk. There are various dairy products like cheese, butter, ghee, paneer, khoa, curd; malai etc., among these paneer is an important indigenous dairy product. The shelf life of paneer is only 1 day at room temperature and 6 days at 10°C [1]. Many techniques have been studied in order to overcome these problems and extend the shelf life of fresh produce, for example, low temperature and high relative humidity, controlled and modified atmosphere packaging, etc. Edible film and coating enhances the quality of food products, protecting them from physical, chemical and microbiological deterioration [2]. Edible coating can act as moisture and gas barriers, control microbial growth, preserve the color, texture and moisture of the product, and can effectively extend the shelf life of the product.

The microbiological quality of paneer depends on the microbiological quality of milk, and the hygiene exercised during manufacture of paneer and its subsequent handling, packaging and storage. Microorganisms such as coliforms, yeasts and moulds that might be present in raw milk get destroyed completely, when milk is heated at 82°C for 5 min. But these microbes may contaminate the product through a number of sources like air, water, equipment, knife, muslin cloth and persons handling the products [3]. These microbes can cause proteolytic and lipolytic changes, discoloration and other defects in the product [4]. According to Sachdeva [5], quality of paneer deteriorates due to the growth of organisms on the surface of paneer during storage. The total counts as well as yeast and mould counts increased during storage of paneer up to 10 days at 5°C. Gupta [6], Thakral [7] and Parashar [8] reported about the increasing trend of the total viable count of paneer treated with 2% potassium sorbate.

The objective of present investigation is to evaluate the effect of edible coating and different packaging treatments on microbial quality of paneer and help to increase the shelf life of paneer.

Materials and Methods

Buffalo milk, whey protein concentrate, citric acid and water were used in the investigation.

Paneer preparation

Paneer was prepared as per the procedure outlined by Sachdeva [5]. Composite edible coating prepared by using whey protein concentrate and applied on the cubes of paneer. Edible coating acted as moisture and gas barrier, control microbial growth, preserve the color, texture and moisture of the product and effectively extend the shelf life of the product.

Then edible coated paneer cubes was packed into polypropylene, LDPE, and laminates and stored at temperatures 5 ± 1°C, 30 ± 1°C and ambient conditions. The stored paneer samples were tested periodically.

Analytical procedures

Total Viable count and Yeast and Mould Count were determined by using APHA [9] method.

Statistical analysis

Statistical analysis was performed using 3 Factorial completely randomized design (CRD). The experimental data were analyzed using the statistical methods of Snedecor and Cochran [10].

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Results and Discussion

The effect of coating and packaging materials on microbiological characteristics of paneer during storage without vacuum were recorded below.

Total Viable Count (TVC)

Packaging material had significant effect ($P \leq 0.05$), whereas coating and temperature and their interactive effect were found significant ($P \leq 0.01$) on total viable count of the product during storage (Table 1).

The results showed that the initial total plate count of control sample of paneer (P_1) on zero days was 3.0×10^2 cfu/g and at the end of 2nd day it was 4.6×10^3 cfu/g. The uncoated samples of paneer packed

in polypropylene (P_2), LDPE (P_3) and laminates (P_4) had microbial count 4.7×10^3 , 8.6×10^3 and 9.65×10^3 cfu/g on 4th day of storage while coated samples of paneer packed in polypropylene (P_5), LDPE (P_6) and laminates (P_7) had microbial count 1.95×10^3 , 2.15×10^3 and 2.35×10^3 cfu/g on 12th day of storage at $30 \pm 1^\circ\text{C}$ (Table 2).

The initial total plate count of control fresh paneer (P_1) was 3.0×10^2 cfu/g which increased at the end of 6th day up to 4.6×10^3 cfu/g. Laminate packed uncoated paneer samples had microbial count 1.08×10^4 cfu/g on 28th day of storage. Whereas, coated samples of paneer packed in polypropylene had microbial count 2.15×10^3 cfu/g on 36th day of storage and LDPE and laminates packed coated paneer had microbial count 1.6×10^3 and 2.75×10^3 cfu/g on 40th day of storage at $5 \pm 1^\circ\text{C}$ (Table 3).

	a	b	c	a*b	b*c	a*c	a*b*c
F value	490.59 *	5.49 *	231.85**	9.32 **	33.30 **	193.42**	37.82 **
SEM ±	19.56	23.96	23.96	33.88	33.88	41.50	58.69
C.D. at 5%	56.23	68.86	68.86	97.38	97.38	119.27	168.68
C.D. at 1%	75.24	92.15	92.15	130.32	130.32	159.61	225.72

* Significant at 5% level of significance, ** significant at 1% level of significance, ns - non significant, a- Coating/uncoating, b- packaging material, c- temperature

Table 1: Effect of treatments on Total viable count of paneer during storage.

Sample code	Microbial Counts (cfu/g) Total viable count							
	Days of storage							
	0	2	4	6	8	10	12	14
P_1	3.0×10^2	4.6×10^3	N.A	-	-	-	-	-
P_2	2.5×10^2	1.25×10^3	4.7×10^3	N.A	-	-	-	-
P_3	2.0×10^2	1.35×10^3	8.6×10^3	N.A	-	-	-	-
P_4	1.5×10^2	1.42×10^3	9.65×10^3	N.A	-	-	-	-
P_5	2.0×10^2	4.5×10^2	7.0×10^2	8.0×10^2	1.25×10^3	1.55×10^3	1.95×10^3	N.A
P_6	1.0×10^2	3.5×10^2	7.5×10^2	9.5×10^2	1.45×10^3	1.66×10^3	2.15×10^3	N.A
P_7	1.0×10^2	5.5×10^2	8.0×10^2	1.05×10^3	1.55×10^3	1.67×10^3	2.35×10^3	N.A

P_1 : Control (without coating & without packaging)

P_2 : Uncoated + LDPE

P_3 : Coated + Polypropylene

P_4 : Coated + Laminate

P_2 : Uncoated + Polypropylene

P_4 : Uncoated + Laminate

P_6 : Coated + LDPE

N.A.: Not Acceptable

Table 2: Effect of coating and packaging materials on Total viable count of paneer during storage at $30 \pm 1^\circ\text{C}$.

Sample Code	Microbial Counts (cfu/g) Total viable count											
	Days of storage											
	0	6	12	18	24	28	32	34	36	38	40	45
P_1	3.0×10^2	4.6×10^3	N.A	-	-	-	-	-	-	-	-	-
P_2	2.5×10^2	9.5×10^2	5.5×10^3	6.3×10^3	7.0×10^3	N.A	-	-	-	-	-	-
P_3	2.0×10^2	8.5×10^2	1.9×10^3	3.0×10^3	5.5×10^3	N.A.	-	-	-	-	-	-
P_4	1.5×10^2	4.2×10^2	2.75×10^3	6.55×10^3	8.5×10^3	1.08×10^4	N.A.	-	-	-	-	-
P_5	2.0×10^2	2.5×10^2	3.0×10^2	1.55×10^3	1.8×10^3	1.85×10^3	1.9×10^3	1.95×10^3	2.15×10^3	N.A	-	-
P_6	1.0×10^2	3.5×10^2	4.2×10^2	6.8×10^2	1.1×10^3	1.25×10^3	1.3×10^3	1.45×10^3	1.5×10^3	1.55×10^3	1.6×10^3	N.A.
P_7	1.0×10^2	4.0×10^2	5.5×10^2	7.5×10^2	9.5×10^2	1.1×10^3	1.25×10^3	1.4×10^3	1.55×10^3	1.95×10^3	2.75×10^3	N.A.

P_1 : Control (without coating & without packaging)

P_3 : Uncoated + LDPE

N.A.: Not Acceptable

P_6 : Coated + LDPE

P_2 : Uncoated + Polypropylene

P_4 : Uncoated + Laminate

P_5 : Coated + Polypropylene

P_7 : Coated + Laminate

Table 3: Effect of coating and packaging materials on Total viable count of paneer during storage at $5 \pm 1^\circ\text{C}$.

The coated samples of paneer packed in polypropylene, LDPE and laminates had total plate count 5.95×10^3 , 5.15×10^3 and 6.55×10^3 cfu/g on 12th day of storage under ambient conditions (Table 4).

Yeast and Moulds counts (Y & M counts)

Coating of paneer, packaging material and temperature and their interaction had significant effect ($P \leq 0.01$) on Y & M counts of the product during storage at $30 \pm 1^\circ\text{C}$ (Tables 5 and 6). The uncoated samples packed in polypropylene, LDPE and laminates had Y & M

counts 1.25×10^3 , 1.85×10^3 and 2.05×10^3 cfu/g on 2nd day. Coated paneer samples packed in polypropylene, LDPE and laminates had Y & M counts 1.45×10^3 , 1.95×10^3 and 2.15×10^3 cfu/g on 12th day of storage.

At $5 \pm 1^\circ\text{C}$, the uncoated samples packed in laminates had Y & M counts 6.0×10^3 cfu/g on 28th day of storage (Table 7). Coated paneer samples packed in polypropylene had Y & M counts 3.7×10^3 cfu/g on 36th day, whereas LDPE and laminates had 3.4×10^3 and 2.15×10^3 cfu/g on 40th day.

Sample Code	Microbial Counts (cfu/g) Total viable count							
	Days of storage							
	0	2	4	6	8	10	12	14
P ₁	3.0×10^2	5.5×10^3	N.A.	-	-	-	-	-
P ₂	2.5×10^2	4.0×10^3	N.A.	-	-	-	-	-
P ₃	2.0×10^2	4.6×10^3	N.A.	-	-	-	-	-
P ₄	1.5×10^2	5.15×10^3	N.A.	-	-	-	-	-
P ₅	2.0×10^2	7.5×10^2	1.15×10^3	2.15×10^3	3.72×10^3	5.15×10^3	5.95×10^3	N.A.
P ₆	1.0×10^2	8.5×10^2	1.75×10^3	2.75×10^3	2.95×10^3	4.95×10^3	5.15×10^3	N.A.
P ₇	1.0×10^2	7.5×10^2	2.15×10^3	2.85×10^3	4.75×10^3	5.45×10^3	6.55×10^3	N.A.

P₁: Control (without coating & without packaging)
 P₂: Uncoated + LDPE
 P₃: Coated + Polypropylene
 P₄: Coated + Laminate

P₂: Uncoated + Polypropylene
 P₄: Uncoated + Laminate
 P₆: Cpspoated + LDPE
 N.A.: Not Acceptable

Table 4: Effect of coating and packaging materials on Total viable count of paneer during storage at ambient conditions.

	a	b	C	a*b	b*c	a*c	a*b*c
F value	380.01 **	160.68 **	342.02 **	150.21 **	86.27 **	186.86 **	80.41 **
SEM ±	14.77	18.09	18.09	25.59	25.59	31.35	44.33
C.D. at 5%	42.38	51.91	51.91	73.41	73.41	89.91	127.16
C.D. at 1%	56.83	69.61	69.61	98.44	98.44	120.56	170.50

* Significant at 5% level of significance, ** significant at 1% level of significance, ns - non significant, a- Coating of paneer, b- packaging material, c- temperature,

Table 5: Effect of treatments (without vacuum) on Yeast & Mould count of paneer during storage.

Sample Code	Microbial Counts (cfu/g) Yeast and Mould count							
	Days of storage							
	0	2	4	6	8	10	12	14
P ₁	3.5×10^2	4.6×10^3	N.A.	-	-	-	-	-
P ₂	2.5×10^2	1.25×10^3	N.A.	-	-	-	-	-
P ₃	2.0×10^2	1.85×10^3	N.A.	-	-	-	-	-
P ₄	1.5×10^2	2.05×10^3	N.A.	-	-	-	-	-
P ₅	2.0×10^2	3.5×10^2	7.5×10^2	9.5×10^2	1.15×10^3	1.25×10^3	1.45×10^3	N.A.
P ₆	1.0×10^2	4.5×10^2	9.0×10^2	1.15×10^3	1.55×10^3	1.62×10^3	1.95×10^3	N.A.
P ₇	2.0×10^2	3.5×10^2	1.12×10^3	1.45×10^3	1.75×10^3	1.85×10^3	2.15×10^3	N.A.

P₁: Control (without coating & without packaging)
 P₂: Uncoated + LDPE
 P₃: Coated + Polypropylene
 P₄: Coated + Laminate

P₂: Uncoated + Polypropylene
 P₄: Uncoated + Laminate
 P₆: Coated + LDPE
 N.A.: Not Acceptable

Table 6: Effect of coating and packaging materials on Yeast and Mould count of paneer during storage at $30 \pm 1^\circ\text{C}$.

Sample Code	Microbial Counts (cfu/g) Yeast and Mould count											
	Days of storage											
	0	6	12	18	24	28	32	34	36	38	40	42
P ₁	3.5×10 ²	3.6×10 ³	N.A	-	-	-	-	-	-	-	-	-
P ₂	2.5×10 ²	3.9×10 ²	1.0 ×10 ³	1.8×10 ³	2.7 ×10 ³	N.A	-	-	-	-	-	-
P ₃	2.0×10 ²	4.5×10 ²	1.15×10 ³	1.95×10 ³	3.0 ×10 ³	N.A.	-	-	-	-	-	-
P ₄	4.0×10 ²	8.0×10 ²	1.35×10 ³	3.55×10 ³	4.5×10 ³	6.0×10 ³	N.A.	-	-	-	-	-
P ₅	2.0×10 ²	3.5×10 ²	3.5×10 ²	4.5×10 ²	2.65×10 ³	2.85×10 ³	2.95×10 ³	3.2×10 ³	3.7×10 ³	N.A	N.A	N.A
P ₆	1.0×10 ²	2.5×10 ²	8.0×10 ²	1.4 ×10 ³	1.8 ×10 ³	1.85×10 ³	1.9 ×10 ³	2.2×10 ³	2.4×10 ³	3.25×10 ³	3.4×10 ³	N.A.
P ₇	1.0×10 ²	2.0×10 ²	2.2×10 ²	3.5×10 ²	4.5×10 ²	5.5×10 ²	5.9×10 ²	6.5×10 ²	8.5×10 ²	1.45×10 ³	2.15×10 ³	N.A.

P₁: Control (without coating & without packaging)
P₂: Uncoated + LDPE
P₃: Coated + Polypropylene
P₄: Coated + Laminate

P₂: Uncoated + Polypropylene
P₄: Uncoated + Laminate
P₆: Coated + LDPE
N.A.: Not Acceptable

Table 7: Effect of coating and packaging materials on Yeast and Mould count of paneer during storage at 5 ± 1°C.

Sample Code	Microbial Counts (cfu/g) Yeast and Mould count							
	Days of storage							
	0	2	4	6	8	10	12	14
P ₁	3.5×10 ²	4.6×10 ³	N.A	-	-	-	-	-
P ₂	2.5×10 ²	3.75×10 ³	N.A	-	-	-	-	-
P ₃	2.0×10 ²	6.3 ×10 ³	N.A	-	-	-	-	-
P ₄	1.5×10 ²	7.1 ×10 ³	N.A	-	-	-	-	-
P ₅	2.0×10 ²	4.5×10 ²	1.35×10 ³	1.75×10 ³	2.22×10 ³	4.75×10 ³	6.15×10 ³	N.A.
P ₆	1.0×10 ²	3.5×10 ²	1.15 ×10 ³	1.65×10 ³	2.45×10 ³	3.75 ×10 ³	4.35×10 ³	N.A.
P ₇	2.0×10 ²	5.5 ×10 ²	1.65 ×10 ³	1.9 ×10 ³	2.75×10 ³	5.65 ×10 ³	6.75 ×10 ³	N.A.

P₁: Control (without coating & without packaging)
P₂: Uncoated + LDPE
P₃: Coated + Polypropylene
P₄: Coated + Laminate

P₂: Uncoated + Polypropylene
P₄: Uncoated + Laminate
P₆: Coated + LDPE
N.A.: Not Acceptable

Table 8: Effect of coating and packaging materials on Yeast and Mould count of paneer during storage at ambient conditions.

The Y & M counts of paneer samples packed in polypropylene, LDPE and laminates was 6.15 × 10³, 4.35 × 10³ and 6.75 × 10³ cfu/g on 12th day of storage at ambient conditions (Table 8).

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