

Preparation, storage and microbiological quality of ready-to-serve low cholesterol masala paneer

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Abstract

Aim: To prepare ready-to-serve masala paneer products with very little cholesterol and to assess their nutritional composition and microbiological safety under refrigerated conditions.

Materials and Methods: Brine dipped and dry salted masala paneer products were prepared using fresh skim milk (fat 0.5 % and solid not fat (SNF) 8.7%), vegetable oil (soybean oil), coriander leaves (1%), mint leaves (1%) and green chilies (0.3%), roasted and grounded cumin seeds (0.3%) and black pepper (0.3%). These products were then analyzed for total energy, fat, protein, cholesterol, calcium (Ca) and magnesium (Mg). The samples were examined for standard plate counts (SPC), yeast and mold counts, coliform counts, *Staphylococcus aureus* counts and *E. coli* count at 2 days interval up to 8 days and also for the presence of *Salmonella* spp. and *Listeria monocytogenes*.

Results: These products with very low cholesterol content (<2mg/100g) can be labeled as cholesterol free paneer products. Nutritional evaluation revealed that 15% of the Daily Reference Value of energy, 38% of protein and 20% of calcium could be met from single serving of 100g of ready-to-serve products. SPC, coliform count and yeast and mold counts in the products were very low while *E. coli*, *Staphylococcus aureus*, *Salmonella* spp. and *Listeria monocytogenes* were not detected. The products were microbiologically safe and remained so for at least 6 days on refrigeration storage.

Conclusion: It is concluded that the ready-to-serve low cholesterol paneer products were hygienic and microbiologically safe.

Keywords: cholesterol free, microbiological safety, nutrition, paneer.

Introduction

Paneer is a tempting, nutritious and delicious indigenous dairy product obtained by acid and heat coagulation of milk. In India, where most people are vegetarian in dietary habits, milk products constitute major source of protein and other essential nutrients. Growing tensed environment and diets rich in fat combined with lack of exercise and physical work are leading to cardiovascular and many other serious health problems in the society. The researchers and medical boards have considered milk fat as a possible risk factor in causing coronary heart diseases because of the presence of more saturated fatty acids and cholesterol.

Cholesterol content in dairy products has become a public health issue requiring development of low fat and low cholesterol milk products [1]. Conventional paneer is quite rich in cholesterol and fat. Paneer because of being prolific in moisture and other nutrients is very prone to contagion. The spoilage in paneer occurs mainly due to the growth of microorganisms like yeasts and molds which bring about various physiochemical changes leading to the development of off-flavour in

the product. Unhygienic paneer can also be a potential source of pathogens like *Staphylococcus aureus* [2, 3] *Salmonella* spp., *Escherichia coli* and *Listeria monocytogenes* [4, 5]. These pathogens find their way into food products through various sources and become potential threat to public health.

Keeping in mind the above facts, the present study was carried to develop ready-to-serve masala paneer products with very little cholesterol and to evaluate their nutritional composition and microbiological stability under refrigerated conditions.

Materials and Methods

Preparation of low cholesterol paneer products: Fresh skim milk (fat 0.5 % and SNF 8.7%) was obtained from the institutional dairy production unit and adjusted to 6% fat with vegetable oil (soybean oil) and mixed with an electric stirrer. Milk was heated to 85°C and then cooled to 72°C. Thoroughly washed coriander leaves (1%), mint leaves (1%) and green chilies (0.3%) were added to the milk. The milk was coagulated with citric acid monohydrate of SRL (Sisco Research Lab. India), Mumbai procured through local supplier and the coagulum was collected on muslin cloth. Roasted and grounded cumin seeds (0.3%) and black pepper (0.3%) were sprinkled while collecting the coagulum and then pressed @ 2-3kg/cm² for 20 minutes (Figure-1).

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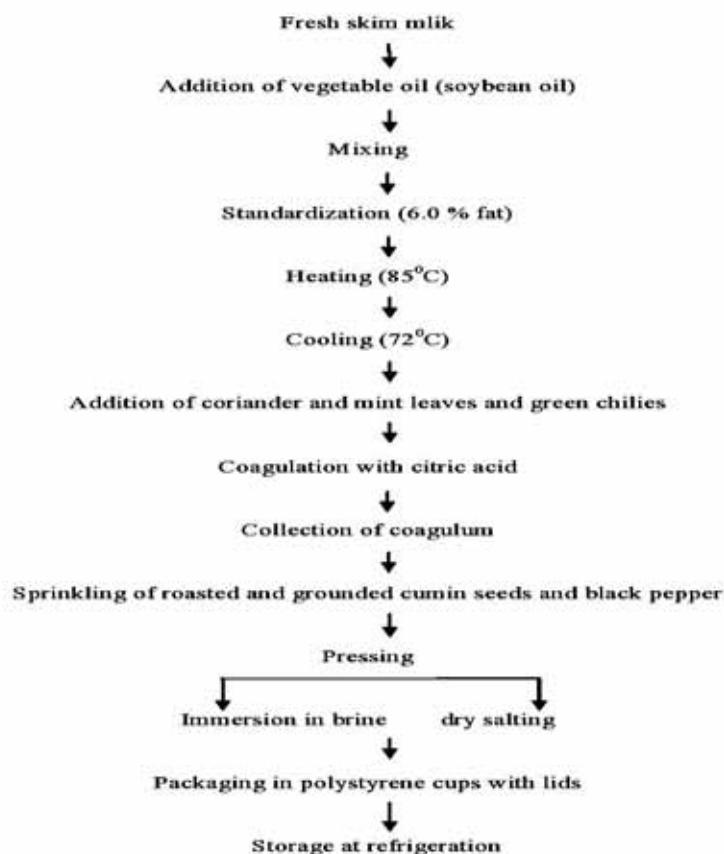


Figure-1: Flow chart for ready-to-serve low cholesterol masala paneer

Preparation of brine dipped (BD) masala paneer: Paneer prepared as described above was cut into cubes (2.5 cm^3). The cubes were dipped in brine solution (5%) for 15 minutes and then hygienically packed in polystyrene cups with lids. The storage was done at refrigeration temperature.

Preparation of dry salted (DS) masala paneer: Paneer was cut into cubes (2.5 cm^3) which were dry salted (3%) for 15 minutes and then packed hygienically in polystyrene cups with lids. The product was stored under refrigeration ($4 \pm 1^\circ\text{C}$).

Nutritional evaluation: The brine dipped (BD) and dry salted (DS) masala paneer samples were analyzed for total energy (by calculation), fat, protein, cholesterol, Ca and Mg. Fat content was measured by Majonnier method [6]. The analysis of protein, cholesterol, Ca and Mg was done by auto analyzer (Erba Mannheim) using fully auto analyzer kit.

Evaluation of cholesterol

Extraction of lipids: Total lipids from sample were extracted according to the method of Angelo *et al.* [7] with slight modification. Paneer sample (25 g) was homogenized with 100 ml solvent (chloroform: methanol, 3:1) for 5 minutes. It was kept for 10 minutes and then this mixture was put on Buchner suction filter. Residue was homogenized two times again as above. Combined organic filtrates were transferred to separating funnel. Two volumes of 0.88% aqueous potassium chloride were added and the funnel was

shaken vigorously. Non lipid material was partitioned to upper aqueous phase by keeping the funnel undisturbed for 12 h. Lower layer was drawn off and dried over sodium sulphate. Lower phase after removing upper phase, if cloudy was made clear by addition of a few drops of methanol. Lipid extract was dried to a constant weight at 60°C , first in water bath and then in hot air oven.

Cholesterol: Extracted lipids were diluted five times with solvent (chloroform: methanol, 3:1). Total cholesterol was assessed in auto analyzer using standard diagnostic kit and expressed as mg cholesterol/100 gram sample.

Storage study: Masala paneer products were stored at refrigeration temperature ($4 \pm 1^\circ\text{C}$). Microbiological analysis was done at 2 days interval up to 8 days.

Microbiological analysis: Standardized paneer obtained from the Department of Livestock Products Technology, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar was used as control. Microbiological analysis of the paneer product samples was carried out by the methods prescribed by Bureau of Indian Standards [8]. The samples were examined for SPC, yeast and mold counts, coliform counts, *S. aureus* counts and *E. coli* count. The samples were also examined for the presence of *Salmonella* spp. and *L. monocytogenes*.

Results

Nutritional composition of developed products: The nutritional composition of the developed masala paneer products has been presented in Table-1. Total fat

Table-1: Nutritional composition of ready-to-serve low cholesterol masala paneer products

Nutritional constituents (Per 100g)	Standardized paneer	Masala Paneer	
		BD	DS
Total energy (Calories)	311.47±0.01	272.01±0.20	289.40±0.02
Total fat (g)	25.55±0.04	21.25±0.26	23.0±0.00
Total cholesterol (mg)	134.30±0.07	1.69±0.18	1.90±0.10
Total proteins (g)	18.63±0.02	18.52±0.24	18.50±0.0
Total carbohydrates (g)	1.75±0.06	1.67±0.22	1.50±0.10
Total ash (g)	2.21±0.03	2.35±0.16	2.40±0.20
Calcium (mg)	233.02±0.01	234.39±0.23	234.60±1.20
Magnesium (mg)	23.89±0.02	23.99±0.21	24.02±1.30

Values are mean ± SEM of five replicates. BD - Brine dipped DS - Dry salted

Table-2: Microbiological quality of masala paneer products during storage under refrigeration condition.

Microbial count (Log ₁₀ cfu/g)	Products	Storage (Days)				
		0	2	4	6	8
Standard plate count	BD	2.74	3.10	4.28	4.33	4.76
	DS	2.43	2.80	3.35	4.21	4.38
Coliform count	BD	1.00	1.60	1.77	1.95	2.11
	DS	ND	1.47	1.69	1.84	1.95
Yeast and mould counts	BD	ND	1.60	2.04	2.25	2.54
	DS	ND	1.47	1.95	2.17	2.38

BD - Brine dipped DS - Dry salted ND - Not Detectable

was lower in the BD (21.25%) and DS (23%) masala paneer products as compared to standardized paneer (25.55%). Cholesterol content of the BD and DS products were 1.69 mg and 1.9 mg per 100g, respectively in comparison to 311.47 mg per 100g in standardized paneer.

Protein, carbohydrates, total ash, calcium and magnesium contents in the developed products are given in Table-1.

Microbiological quality on storage at refrigeration temperature: The microbiological quality of the two products at different storage intervals is shown in Table- 2. On day 0, SPC in the BD and DS products was 550/g and 270/g, respectively while coliform count was 10/g in the BD and undetectable in DS. It was observed from the data that SPC had shown an increasing trend during entire storage period, an increase was observed to the level of 58010²/g and 24010²/g while coiliform count increased up to 130/g and 90/g in the BD and DS products, respectively at the end of storage (8th day).

Yeasts and molds were not detected on day 0, but these become detectable in both the products after 2 days and subsequently increased in number. The Yeast and Mould count was increased up to 350/g and 245/g in the BD and DS products, It is important to mention this in the results respectively at the end of storage (8th day).

E. coli, *S. aureus*, *Salmonella* spp. and *L. monocytogens* were absent in both the products at all stages of storage.

Discussion

Nutritional composition of developed products: Vegetable oil used to prepare the paneer of acceptable tenure and flavor might have less retention by the protein matrix of paneer. Fresh coriander leaves added in the product also might contribute towards more

retention of moisture in the product and consequently lower fat content. Ankita [9] also observed 21% fat and 55% moisture content in masala paneer prepared from skimmed milk with added vegetable oil. Similar observations were also made by Bajwa *et al.* [10] who worked on vegetable impregnated paneer. They reported that protein content declined with the addition of coriander and mint leaves in vegetable impregnated paneer. This may be attributed because of lower protein content of the coriander and mint leaves and some losses may occur during brine dipping leading to loss of some salt soluble proteins during immersion in brine.

Low cholesterol in paneer was attained because the skimmed milk has only 15% total cholesterol of the whole milk and the vegetable oil does not contain cholesterol.

The results revealed that 15% of Daily Reference Value (DRV) of energy, 38% DRV of protein, 20% DRV of calcium and 6% of magnesium could be met from a single serving of 100g of the developed product. The product can be categorized as cholesterol free product according to the provision in Nutritional Labeling and Education Act 1990 of United State Food and Drug Administration wherein <2 mg cholesterol per serving is classified as cholesterol free product.

Microbiological changes of developed products on storage at refrigeration temperature: SPC had shown increasing trend with extended storage. However, on storage at refrigeration temperature, SPC was well within the permissible limits under (FSSAI) Regulations, [11] for paneer i.e. 50,000/g upto 6 days in BD products and up to 8 days in DS product (Figure-2). This may be attributed to the presence of salt and spices. Bactericidal and bacteriostatic properties of spices are well documented in the literature [12, 13, 14]. There was gradual rise in the SPC, attaining log₁₀ cfu/g values of 4.76 (5.8×10⁴/g) 4.38 (2.4×10⁴/g) in BD

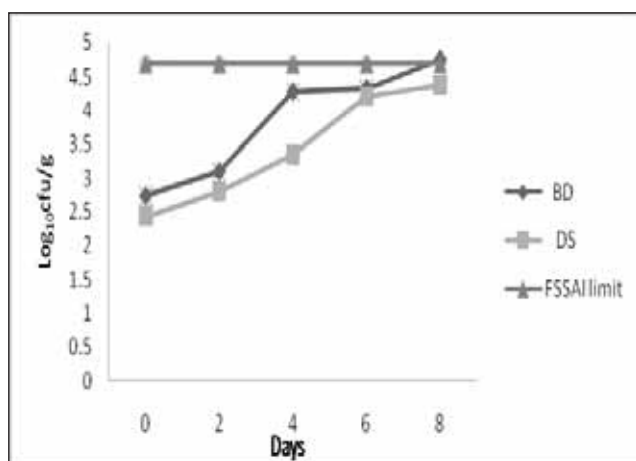


Figure-2: SPC in low cholesterol masala paneer products

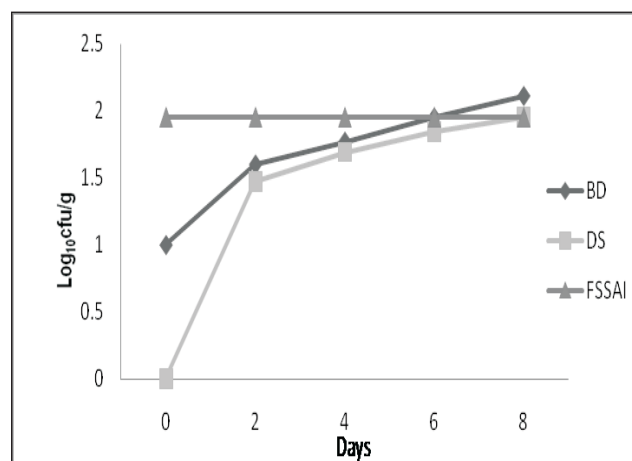


Figure-3: Coliform counts in low cholesterol masala paneer products

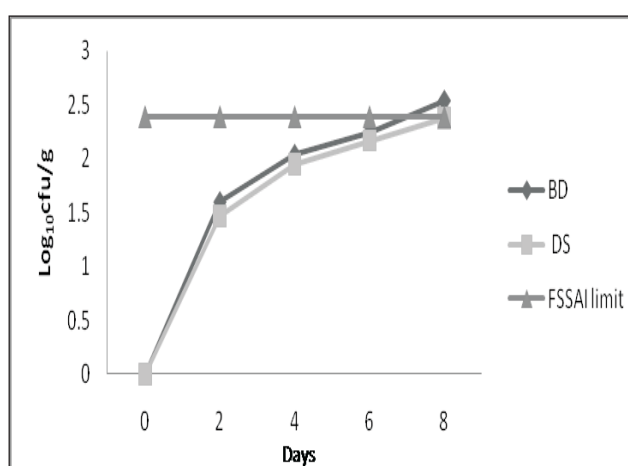


Figure-4: Yeast and mold counts in low cholesterol masala paneer products

and DS products, respectively after 8 days. Results obtained in the present study are in agreement with the results reported by Ankita [9] who observed SPC (log cfu/g) of BD products on day zero was 4.15, which increased up to the level of 5.78 on day 10. Whereas, DS products had SPC count of 4.08 when freshly prepared. The number was reached to the levels of 5.29 on day 10 of storage.

Coliform counts also showed gradual rise in numbers in both the products but remained below the FSSAI prescribed levels (Figure-3). Their counts remained below the permissible limits prescribed by FSSAI (Figure-3) for paneer i.e. not more than 250/g at least up to 6 days. Ankita [9] has also reported similar observations on the microbiology of the products developed by her.

As is evident from the Table-2 and Figure-4 data with the advancement of storage period, yeast and molds counts crossed the permissible limits of FSSAI for paneer i.e. not more than 250/g. Results obtained in the present study are in agreement with the result reported by Ankita [9] who observed log cfu/g values of masala paneer on day zero was 2.32 in BD products, increased up to the level of 3.31 on day 10 of storage. In case of DS products, the number was found to be 2.19

when assessed immediately after preparation. And the counts increased to the levels of 3.07 at day 10 of storage. Bajwa *et al.* [10] has also reported similar changes in microbiology of the vegetable impregnated and salted paneer products on storage. Whereas both the products were free from pathogens during the entire study period.

Conclusion

It is concluded that the ready-to-serve low cholesterol products were hygienic and microbiologically safe. The technologies generated may be explored for value addition to paneer for preparing a safe ready to serve product. The acceptance of the cholesterol free paneer product may be explored.

Authors' contributions

RSD have designed the study. SRG and VJ have planned the research experiments. MR performed the research experiments. MR and SG drafted and revised the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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