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Standardization and quality evaluation of low fat carotene rich paneer for its Physico-chemical, sensory and microbiological properties during storage

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Abstract
Low fat carotene rich paneer was developed by blending skimmed milk and carrot juice at different proportions. Paneer developed from 70:30 blend combinations exhibited higher sensory score. The developed product was packed in low density polyethylene pouch (LDPE) and stored at 4 and 15 ˚C in order to assess the quality during storage. Significant difference in textural parameters was noted for various paneer samples prepared from blends of skimmed milk and carrot juice. Physicochemical properties of paneer shows that acidity significantly increased, while moisture, fat, protein, lactose, energy, pH significantly reduced and ash, carotenoids content exhibited insignificant changes during storage. Sensory properties of sample show that the product was found to be safely acceptable upto 7 days at 4 ˚C and 3 days at 15 ˚C. Microbiological properties show that the total plate count (TPC), coliform, yeasts & moulds counts significantly increased during the entire storage period.

Keywords: Paneer, carotene rich, low fat product, sensory properties, carrot juice, microbial properties

Introduction
Paneer is an Indian variety of soft unripened cheese manufactured by high heat treatment and direct acidification process. It belongs to the non-renneted, directly acidified cheese which also includes most of the Latin American white cheese used throughout the south and central Mexico and Caribbean islands (Torres and Chandan, 1981; Chandan, 2007) [19, 5]. Paneer is a highly popular product throughout the country, having many uses starting from its consumption in raw form to the preparation of several varieties of culinary dishes and snacks and sweet meats like rasogolla, rasamalai, sandesh etc. which are actually produced from chhana, which is unpressed form of paneer. Good quality paneer is characterized by a marble white color, sweetish, mildly acidic taste, nutty flavour, spongy body and closely knit smooth texture. It is estimated that about 50 per cent of total milk produced in India is converted into various milk products like ghee, butter, paneer, chhana, khoa etc., among these paneer is one of the major milk products produced in India, especially in the north. According to an estimate about 5 per cent of milk produced in India is converted into paneer (Chandan, 2007) [5].
Traditionally paneer is prepared from full fat milk resulting in rich flavor, soft consistency and lower sliceability. Paneer is a ubiquitous product in India, having great demand among the consumers in national and International market. The product has a shelf life of 6 days at 10 ˚C (Jagannath *et al*., 2001) [11]. The conventional paneer is quite rich in fat content, which not only pushes up the price of paneer but also makes it unsuitable to those consumers who are conscious about high fat, as milk fat increases the risk of coronary heart diseases. The research survey has shown that quite good quality paneer could be manufactured from milk with fat content as low as 3.0% (Kanawjia and Singh, 2000) [12]. Milk and milk products appear to be the almost perfect foods, but provide none of the 4 mg of carotene required daily for adults. Carrot, which is one of the root vegetable used in a variety of ways such as salads, as vegetables, added to spicy rice or daal dishes. They are the richest source of carotene, precursor of vitamin A and they are essential for good vision. Juice obtained from carrot is widely marketed as a health drink because of rich source of carotenoids. Generally the dairy products are the richest source of fat and repeated consumption of these products will lead the consumers in several health related diseases like stroke and some cardiac ailments etc. Remedy for such type of problems can be put to an end by utilizing skimmed milk for product development. Carrot, which is found to contain natural antioxidant like carotenoids and they fall under the category of alkaline vegetables, so they can be easily blended with skimmed milk for development of low fat carotene rich paneer.

Physico-chemical, sensory and microbiological properties play an important role in deciding the product overall quality characteristics for both fresh and stored products. Therefore, in this study low fat carotene rich paneer was developed by incorporating skimmed milk and carrot juice in order to evaluate its overall acceptability during storage period, which can be judged over by Physico-chemical, sensory and microbiological properties.

Materials and Methods

Raw materials

Skimmed milk powder was brought from Visakha Dairy, Visakhapatnam, India. Carrot and Citric acid (Food grade) were purchased from local market. All other chemical reagents were procured from E.Merck and Loba Chemicals Limited, Mumbai, India.

Development of low fat carotene rich paneer

The development of low fat carotene rich paneer was carried out as per the procedure of Sukumar De (2001) [18].

Preparation of carrot juice and skimmed milk

The carrots were washed thoroughly, skin was scrapped with the help of hand peeler, sliced into cubes with the help of stainless steel knifes, crushed in a mixer grinder after incorporation of 10% water, extract was squeezed in muslin cloth and finally sieved through strainer of 30 meshes to get fine juice. The carrot juice was pasteurized at 85 ˚C for 30 min in water bath. The skimmed milk was prepared by reconstituting skimmed milk powder @ 25g to 100 ml of hot water (i.e. 1:4 ratio), stirred well to disperse clod particles, sieved through strainer of 30 meshes to get homogenous sample. The reconstituted milk was then pasteurized at 75˚C for 20 min, cooled and utilized for development of final product.

Paneer preparation

The low fat carotene rich paneer was prepared by blending desired amount of reconstituted skimmed milk with carrot juice @ 50:50, 60:40, 70:30, 80:20, 90:10 and 100:0 ratio's. The skimmed milk-carrot juice blend was then heated up to 90 ˚C without holding, cooled to 70 ˚C and coagulated using 2% citric acid as coagulating agent at this temperature with continuous and gentle stirring. The coagulum thus obtained was left undisturbed for approximately 5 min and the temperature of the contents was not allowed to drop below 60˚C at this stage. Whey was drained by filtering contents through a fine muslin cloth. The coagulum was then filled in wooden hoops with holes on the all sides and bottom to facilitate quick and efficient expulsion of whey.

The hoops were lined with strong and clean muslin cloth from inside and the whole mass was then pressed in hoops by applying pressure of about 230 kg/m^2 on the lid of the hoop for about 15 min. The pressed block of curd was cut into pieces of suitable size (7.5 x 7.5 x 7.5 cm^3) and immersed in chilled water (4 ˚C) for 1 h. The paneer was then taken out of water and drained well, wiped clean and they were transferred to low density polyethylene (LDPE) packages of size 15cm x 20cm, sealed and stored at 4 and 15 ˚C in order to assess the shelf stability.

Physico-chemical properties

The reconstituted skimmed milk was analyzed for various physico-chemical properties *viz*., moisture by gravimetric method, total proteins by micro-Kjeldahl method, fat by Gerbers method (ISI, 1977) [10], pH by combined electrode digital pH meter and SNF by difference. Paneer was evaluated for moisture, fat, proteins and ash as per the method of AOAC (2003) [4]. The pH of paneer was determined by the method of Okeeffe *et al.* (1976) [13]. The carotenoids were determined using an ultra violet – visible recording spectrophotometer at 450 nm (UV 1601, Shimadzu Corp., Columbia, USA) as per the method described by Arya *et al.* (1979) [3]. The texture profile analysis of sample was carried out using TA.XT2 Texture Analyzer (Texture Technologies Corp., UK, Model TA.XT2, version 05.16) of Stable micro System equipped with 5-kg load cell. A perplex cylindrical probe of 25 mm diameter was used to compress 10 mm diameter and approximately 10 mm long paneer samples.

Sensory properties

The sensory properties of low fat carotene rich paneer was evaluated by serving them in glass bowl to a panel of 15 trained panelist's after labeling with three-digit random codes. Panelists were provided with distilled water to clean their mouths between samples. All evaluations were conducted under white light at room temperature on the same day in the Food Science & Technology Department, Institute of Science, GITAM University, Visakhapatnam.

The paneer samples were presented in random order and panelists were asked to rate their assessment of color, aroma, taste, texture and overall acceptability on a 1–9-point hedonic scale (1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9 = like extremely) (Amerine *et al.*, 1965) [2]. A score of 6 was considered as a limit of acceptability for all sensory attributes tested.

Microbiological properties

For determining the total viable count, coliform, yeast & moulds and spores count in low fat carotene rich paneer, the 10^{-1} dilution was made by diluting 10g product with 90ml of physiological saline. Further, tenfold serial dilutions, ranging from 10^{-2} to 10^{-7} were prepared and the microbial counts were determined according to the pour plate method of Harrigan and McCance (1976) [9]. Total viable counts were determined using plate count agar incubated at 30˚C for 2 days. Counts of spores were determined using dextrose tryptone agar incubated at 37˚C for 2 days. The counts of yeasts and moulds were determined using potato dextrose agar (PDA), acidified to pH 3.5 with tartaric acid and incubated at 25˚C for 5 days. Coliforms were determined using violet red bile agar incubated at 37˚C for 2 days.

Statistical analysis

All experiments were run in triplicate. Data were subjected to analysis of variance (ANOVA) using Microsoft Excel 2000 (Microsoft Corp., Washington, USA).The paired comparisons of means were performed using Duncan's test (Steel and Torrie, 1980) [17].

Results and Discussion

Composition of reconstituted skimmed milk powder

The Table 1 shows the chemical composition of reconstituted skimmed milk powder sample used for developing low fat carotene rich paneer. The moisture content (80.86%), fat content (0.14%), protein content (7.06%), carbohydrate (10.12%), ash content (1.82%) and pH of the reconstituted

sample were found to be within the prescribed limit of FSSAI (2013) [8].

Sensory score evaluation of low fat carotene rich paneer samples

The Table 2 Shows the mean sensory score evaluation of various low fat carotene rich paneer prepared from blends of skimmed milk and carrot. The result shows that as the carrot juice incorporation increases in the blend mix, the color score of the paneer also increases significantly ($p<0.05$). The blend combination of 50:50 recorded higher score and 90:10 combination recorded lower score, this might be incorporation of more amount of carrot juice which might have enhanced the final color of the product to a greater extent. In terms of aroma score, the blend proportions ranging from 70:30 to 90:10 recorded higher scores, while other combinations *viz*. 60:40 and 50:50 recorded lesser score, which may be ascribed to existence of typical carrot flavor in the final developed product. The 70:30 blend proportions exhibited greater score for taste, texture and overall acceptability, which may be because of presence of optimum concentration of total solids that might have enhanced the texture score to a greater extent and enhanced taste score may be due to presence of acceptable level of skimmed milk and carrot solids, which finally increased the overall acceptability to a higher side.

The 50:50 combination recorded lower score value, this may be due to presence of lesser amount of total solids, which might have resulted the end product in very soft texture and the taste score reduced, which may be because of presence of predominant components of carrot and these scores finally reduced the overall acceptability of the resultant product to a greater extent.

Nutritional properties of low fat carotene rich paneer samples

The Table 3 shows the nutritional properties of various low fat carotene rich paneer prepared from blend proportions of skimmed milk and carrot juice. The results shows that the paneer prepared from 50:50 blend combination recorded higher moisture content, while the 90:10 blend combination recorded lesser moisture, this may be attributed to presence of more amount of water content in the carrot solids, which might have enhanced the moisture content to a greater extent. The fat content of paneer was in the range of 12.6 – 13.5 % for 50:50 and 90:10 blend respectively. As the carrot juice incorporation during product preparation increases, the fat content of the resultant product reduces. The 90:10 blend combination recorded more protein content of 24.91% when compared to 50:50 of 23.05%, this may be because of presence of more amount of SNF in samples during its preparation. No significant difference ($p>0.05$) in ash content, lactose content, acidity and pH of the various low fat carotene rich paneer samples were noted. The 90:10 blend proportions recorded more energy content of 239.41 kcal, because of presence of more amount of protein, fat and lactose, which might have contributed to higher calories of resultant product, while paneer prepared from 50:50 blend combination recorded lesser energy of 220.13 kcal.

As like energy content the 90:10 blend proportions exhibited higher yield of paneer i.e. 18.61%, while 50:50 combination gave lesser yield of 13.06%, this may be due to presence of lesser amount of total solids in the final blend combination which might have resulted in low yield of the final product. The 50:50 blend proportions recorded higher carotenoids content when compared to 90:10; this may be because of higher incorporated content of carrot solids, which might have enhanced the concentration of carotenoids content in the final end product to a greater side.

Textural properties of low fat carotene rich paneer samples

The Table 4 shows the textural properties of low fat carotene rich paneer prepared from blends of skimmed milk and carrot juice. The results shows that the 90:10 blend exhibited higher firmness value, which may be accounted to presence of more amount of skimmed milk protein solids in the final coagulated blend before pressing and paneer blend combination 50:50 showed lesser firmness value. As like firmness the gumminess, springiness, resilience, chewiness and cohesiveness were also recorded similar results. The higher springiness value may be attributed to binding characteristics of skimmed milk protein solids, causing the formation of a gel matrix which in turn results in a more stable product (El-Nagar *et al*., 2002) [7]. The higher gumminess and chewiness value may be because of exhibiting a semi solid behavior rather than true solid. The higher cohesiveness value corresponded to samples with a weak gel structure. The structure of a weak gel is mainly formed by temporary crosslink's which may be largely reformed after the applied stress is removed and hence it shows high cohesiveness (Raphaelides *et al*., 1996) [16]. Significant difference ($p<0.05$) in textural parameters was noted for various low fat carotene rich paneer prepared from blends of skimmed milk and carrot juice.

Stability of low fat carotene rich paneer

Sensory properties

The Table 5 shows the sensory evaluation of low fat carotene rich paneer stored in low density polyethylene pouches at different temperatures. The results shows that the color, aroma, taste, texture and overall acceptability of paneer significantly decreased ($p<0.05$) during entire period of storage for samples stored at 4 and 15˚C. The product was found to be acceptable upto to a period of 7 days when it was stored at 4˚C and 3 days at 15˚C. Significant reduction in color score may be due to degradation of pigments by microorganisms, which might have decreased the intensity of color for the stored samples, enzymatic / biochemical reactions of these microorganisms might have reduced the flavor i.e. aroma and taste score. The reduction in texture score may be due to breakdown of protein gels by the microorganisms into smaller or tiny particles, which might have reduced the texture score drastically and collectively reduction of all these scores had brought remarkable changes for overall acceptability of the paneer stored at above temperature conditions. Ahuja *et al*. (2012) [1] were also observed similar pattern of reduction in sensory scores as a result of advancement of storage period for paneer samples stored at 3 ± 1 ˚C upto a period of 40 days under different packaging conditions.

Physico-chemical properties

The Table 6 shows the physico-chemical evaluation of low fat carotene rich paneer stored in LDPE pouch at 4 and 15˚C. The result shows that the moisture content of samples decreased from 58.2% to 58.0% and 57.6% at 4 and 15˚C, respectively. Ahuja *et al.* (2012) [1] were also observed reduction in moisture content as a result of advancement of storage period for paneer samples stored at 3 ± 1 ˚C upto a period of 40 days under different packaging conditions. Significant loss

($p<0.05$) in moisture content was noticed for paneer samples stored at above conditions.

As like moisture, the fat and protein content of the product were also reduced from 13.0% to 12.0% & 11.8%; 23.87% to 22.46 and 22.01% at 4 and 15˚C, and this may be due to lipolytic and proteolytic reaction as a result of enzymatic reaction of microorganisms, which might have significantly reduced the fat and protein content to the greater proportions ($p<0.05$). Ash content

of stored product exhibited insignificant changes during entire period of storage ($p>0.05$). The lactose content of the paneer was 2.32% and it significantly ($p<0.05$) reduced to 2.02% and 1.90% during entire period of storage, and this may be attributed to break down of carbohydrates as a result of putrid fermentation process by microorganisms in the stored final product. The energy content also significantly ($p<0.05$) reduced from 230.07 kcal to 220.32 and 207.57 kcal at 4 and 15˚C. The decrease in protein, fat and carbohydrates contents during storage period had resulted in significant changes in energy levels. The acidity of stored paneer sample was found to be 0.23% and this significantly ($p<0.05$) increased to 0.42 and 0.47% as a result of fermentation by undesirable organisms (Daifas *et al*., 1999) [6], which might have increased the lactic acid content of the final stored product to a greater concentration. The increase in acidity of the stored product significantly ($p<0.05$) reduced the pH of the product from 5.53 to 5.34 and 5.26% during storage at 4 and 15˚C respectively. Verma *et al*. (2007) [20] also observed increase in acidity and decrease in pH for paneer tikka samples packed under modified atmospheric storage and stored at 7 ± 1˚ C upto a period of 40 days. Insignificant reduction ($p>0.05$) in carotenoids content were observed for samples stored at 4 and 15˚C upto a period of 10days. Ramasamy *et al*. (2012) [14] were also reported similar results of slight reduction in carotenoids content in carrot juice incorporated flavored milk for a period of 3 months under various storage conditions.

Microbiological properties

The Table 7 shows the microbiological evaluation of low fat carotene rich paneer stored in LDPE pouches at 4 and 15˚C. The result shows that the initial TPC count of stored paneer sample was found to be 3.52 $x10^5$ CFU/g and this significantly increased ($p<0.05$) to 5.74 and 6.72 x 10^5 CFU/g at the end of the storage period. The increase in TPC count during storage period may be attributed to moist air contamination during storage which might have increased the counts to a greater extent. The Coliform count of the stored sample was 75.43 $x10^1$ CFU/g, which significantly increased ($p<0.05$) to 96.75 and 105.5 x 10^1 CFU/g at the end of the storage period, which may be because of moist air contamination during storage. The recorded yeast and moulds counts were 220.28 x 10^1 initially, which significantly increased ($p<0.05$) to 260.77 and 274.39 x 10^1 CFU/g at the end of the storage period due to moist air contamination. Rani *et al*. (2014) [15] were also observed similar increase in counts of TPC, coliform, yeasts & moulds during storage of ready-to-serve low cholesterol masala paneer in refrigerated storage upto a period of 8 days. According to FSSAI (2013) [8], a maximum count of $5x10^5$ CFU/g of TPC, $<90x10^1$ CFU/g of coliform, $<250x10^1$ CFU/g of yeasts & moulds were allowed in paneer sample. In this case the product was acceptable upto 3 days at 4˚C and 7 days at 15˚C without exceeding the required limits. Therefore the paneer sample can be safely consumed upto 7 days when it was stored in 4˚C and 3 days at 15˚C respectively.

Table 1: Chemical composition* of reconstituted skimmed milk powder

S. No	Name of the constituent	Composition (%)
1.	Moisture	80.86 ± 0.27
2.	Fat	0.14 ±0.31
3.	Protein	7.06 ±0.40
4.	Carbohydrate	10.12 ±0.51
5.	Ash	1.82 ±0.49
6.	pH	6.6 ±0.04

*****Mean±SD of triplicate analysis

Table 2: Mean sensory score* evaluation of various low fat carotene rich paneer (n=15)

Blend proportions of skimmed milk and carrot juice	Color	Aroma	Taste	Texture	Overall acceptability
50:50	8.20±0.46[a]	6.01±0.90a	6.52±0.60a	6.22±0.42a	6.73±0.58 [a]
60:40	8.11±0.62 [a]	6.54±0.81b	7.46±0.45b	7.09±0.32b	7.30±0.61[b]
70:30	8.03±0.49 [a]	7.94±0.40c	8.31±0.56c	8.26±0.71c	8.13±0.49[c]
80:20	7.82±0.55ba	7.61±0.63d	7.75±0.67d	8.09±0.90dc	7.81±0.32 [d]
90:10	7.61±0.69ba	7.07±0.77e	7.25±0.81b	8.14±0.40dc	7.51±0.54 [eb]

*****Mean±SD

Mean values in the same column bearing the common superscript do not differ significantly ($p>0.05$)

Table 3: Nutritional properties* of various low fat carotene rich paneer

Paneer made from skimmed milk and carrot juice blends	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Lactose (%)	Energy (Kcal)	Acidity (%)	pH	Yield (%)	Carotenoids (mg/100g)
50:50	58.6± 0.45 [a]	12.6± 0.24 [a]	23.05± 0.56 [a]	2.70± 0.21 [a]	2.27± 0.12 [a]	220.13± 0.82 [a]	0.20± 0.02 [a]	5.55± 0.03 [a]	13.06± 0.45 [a]	22.31± 0.50 [a]
60:40	58.4± 0.32 [a]	12.8± 0.19 [a]	23.27± 0.78 [a]	2.68± 0.34 [a]	2.29± 0.24 [a]	226.45 ±0.67 [b]	0.22± 0.01 [a]	5.54± 0.02 [a]	14.49 ±0.59 [b]	18.08± 0.61 [b]
70:30	58.2± 0.55 [a]	13.0± 0.31 [a]	23.87± 0.41 [b]	2.64± 0.40 [a]	2.32± 0.26 [a]	230.07 ±0.91 [c]	0.23± 0.03 [a]	5.53± 0.01 [a]	15.84 ±0.67 [c]	14.34± 0.45 [c]
80:20	57.9± 0.62 [b]	13.2± 0.28ba	24.32± 0.67 [b]	2.61± 0.25 [a]	2.36± 0.20 [a]	234.52 ±0.76 [d]	0.24± 0.01 [a]	5.52± 0.04 [a]	17.20± 0.41 [d]	10.01± 0.39 [d]
90:10	57.7± 0.40 [b]	13.5± 0.20ba	24.91± 0.71 [bc]	2.54± 0.37 [a]	2.40± 0.19 [a]	239.41 ±0.87 [e]	0.25± 0.02 [a]	5.51± 0.02 [a]	18.61 ±0.63 [e]	6.11± 0.70[e]

*****Mean±SD of triplicate analysis

Mean values in the same column bearing the common superscript do not differ significantly ($p>0.05$)

Table 4: Textural properties* of various low fat carotene rich paneer

Paneer made from skimmed milk and carrot juice blends	Firmness (N)	Gumminess (N mJ/mJ)	Springiness (mm/mm)	Resilience (mJ/mJ)	Chewiness (N mm)	Cohesiveness (mJ/mJ)
50:50	3.25±0.45 [a]	1.42±0.24 [a]	0.61±0.56 [a]	0.32 ±0.21 [a]	1.27±0.12 [a]	0.19±0.10 [a]
60:40	3.87±0.32 [b]	1.71±0.19 [a]	0.70±0.78 [a]	0.43±0.17 [a]	1.65±0.24 [a]	0.30±0.14 [a]
70:30	4.37±0.55 [c]	2.07±0.31 [ba]	0.78±0.41 [a]	0.51±0.19 [a]	1.92±0.26 [ba]	0.40±0.13 [a]
80:20	4.81±0.62 [dc]	2.35±0.28 [ba]	0.86±0.67 [a]	0.60±0.25 [a]	2.23±0.29 [ba]	0.47±0.20 [a]
90:10	5.24±0.40 [dc]	2.72 ±0.20 [bca]	0.92±0.71 [ba]	0.67±0.27 [ba]	2.57±0.19 [bca]	0.54±0.17 [ba]

*****Mean±SD of triplicate analysis
Mean values in the same column bearing the common superscript do not differ significantly (p>0.05)

Table 5: Sensory evaluation* of stored low fat carotene rich paneer (n=15)

Storage period (in days)	Color		Aroma		Taste		Texture	Overall acceptability		
	4˚ C	15˚ C	4˚ C	15˚ C	4˚ C	15˚ C	4˚ C	15˚ C	4˚ C	15 ˚C
0	8.03 ± 0.30	8.03 ± 0.30	7.94 ± 0.63	7.94 ± 0.63	8.31 ± 0.49	8.31 ± 0.49	8.26 ± 0.66	8.26 ± 0.66	8.13 ± 0.41	8.13 ± 0.41
3	7.44 ± 0.75	6.81 ± 0.45	7.08 ± 0.41	6.32 ± 0.74	7.41 ± 0.37	6.96± 0.57	7.29 ± 0.43	7.41 ± 0.52	7.30 ± 0.91	6.87 ± 0.65
7	6.71 ± 0.82	5.53 ± 0.36	6.45 ± 0.55	5.62 ± 0.66	6.73 ± 0.42	5.89 ± 0.38	6.87± 0.61	6.54 ± 0.74	6.69 ± 0.53	5.89 ± 0.72
10	5.90 ± 0.46	5.02 ± 0.48	5.34 ± 0.40	5.07 ± 0.87	5.67 ± 0.50	5.19 ± 0.72	5.36 ± 0.54	5.85 ± 0.85	5.56 ± 0.87	5.28 ± 0.52

*****Mean±SD

Table 6: Physico-chemical evaluation* of stored low fat carotene rich paneer

Storage period(in days)	Moisture (%)		Fat (%)		Protein (%)		Ash (%)		Lactose (%)	
	4 ˚C	15˚ C	4˚ C	15˚ C	4˚ C	15˚ C	4˚ C	15˚ C	4˚ C	15˚ C
0	58.2±0.55	58.2±0.55	13.0±0.31	13.0±0.31	23.87±0.41	23.87±0.41	2.64±0.40	2.64±0.40	2.32±0.26	2.32±0.26
3	58.2±0.55	58.2±0.37	12.8±0.45	12.4±0.71	23.51±0.60	23.29±0.51	2.64±0.30	2.62±0.22	2.25±0.34	2.13±0.49
7	58.1 ±0.42	57.8±0.51	12.5±0.61	12.0±0.39	23.09±0.71	22.64±0.48	2.62±0.29	2.60±0.34	2.19±0.51	2.00±0.47
10	58.0 ±0.29	57.6 ±0.63	12.0±0.63	11.8±0.59	22.46±0.71	22.01±0.41	2.60±0.41	2.58±0.52	2.02±0.66	1.90±0.56

Table 7: Microbiological evaluation* of stored low fat carotene rich paneer

Storage period (in days)	TPC X 10^5 CFU/g		Coliform count X 10^1 CFU/g		Yeast & Moulds count X 10^1 CFU/g	
	4˚C	15˚C	4˚C	15˚C	4˚C	15˚C
0	3.52±0.45	3.52±0.45	75.43±0.48	75.43±0.48	220.28±0.56	220.28±0.56
3	4.20±0.67	5.23±0.62	82.26±0.81	87.48±0.52	234.15±0.47	244.59±0.95
7	4.91±0.51	6.06±0.72	88.91±0.62	97.63±0.47	243.68±0.69	260.84±0.74
10	5.74±0.76	6.72±0.55	96.75±0.39	105.50±0.66	260.77±0.83	274.39±0.58

*****Mean±SD of triplicate analysis
TPC: Total plate count, CFU: Colony forming unit

Conclusions

Low fat carotene rich paneer can be standardized by utilizing blends of skimmed milk and carrot juice in different blend combinations. Among them, the 70:30 blend combination exhibiter superior organoleptic characteristics. The product can be safely stored and consumed upto a period of 7 days under refrigerated storage condition i.e. at 4˚C. This product can be highly useful for people, who are suffering from several cardiac related diseases and it also contributes good vision.

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