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Development of Reduced Fat Paneer from Reconstituted Milk

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ABSTRACT

Background: The present investigation was studied to optimize process and formulation for manufacturing reduced fat paneer from reconstituted milk (RCM). The shelf life of milk can increase by converting it into powder and used wherever unavailability of fresh milk is there. By reconstituting milk powder with water and optimizing process, it is possible to manufacture various traditional dairy products.

Methods: In this research which was conducted during 2019-2021, all the three samples of paneer prepared from RCM were coagulated at three different temperatures *i.e*. 70, 75 and 80°C. The fat and MSNF content in RCM were also optimized from different 12 combinations and the parameters of reduced fat paneer also studied.

Result: The obtained results from RCM coagulated at 70°C temperature showed better body and texture in paneer. Based on sensory attributes, paneer prepared from 1.5 per cent fat and 12.0 per cent MSNF in RCM coagulated at 70°C using 1.0 per cent citric acid solution gave higher overall acceptability score.

Key words: Paneer, Reconstituted milk, Reduced-fat.

INTRODUCTION

Paneer, a popular heat and acid coagulated traditional dairy product is an unripened variety of soft cheese. Paneer provides an easy means of conserving and preserving valuable milk solids mostly milk protein and fat. The paneer market in India exhibited strong increase in sales during 2015-2020. Paneer dishes are very popular among people of all age groups in India. The deep frying property of paneer gives it wider acceptance to make many culinary dishes and preferred for making snacks, pakoras or fried paneer chunks (Aneja, 2007). The day-to-day consumption of paneer amongst middle class Indians is increasing. IMARC group expects the paneer market in India to grow at a CAGR of 15.0 per cent during 2021-2026. The IMARC (2020) examined the Indian paneer market in 15 major states from which Utter Pradesh represented the region with highest market share in the country followed by Maharashtra and Rajasthan. Some prominent players of paneer in the market include GCMMF, Parag milk foods, Mother dairy, RCDFL and VRS foods Ltd.

Paneer prepared from standardized milk is rich in fat content *i.e*. 23.0-26.0 per cent. Nowadays people are very health conscious and refuse to consume high calorie foods *viz*. foods rich in fat. Many research works reveal that high-fat diets increased risk of obesity, atherosclerosis, coronary heart disease, elevated blood pressure and tissue injury (Madadlou *et al.,* 2005). Wu *et al.* (2010) found that a high-fat diet causes increased lipid accumulation, induction of endoplasmic reticulum stress pathway genes, altered mitochondrial membrane potential and increased incidence of apoptosis in ovarian cells ultimately cause lipotoxicity. Excessive intake of high-fat diet can simultaneously cause obesity and psychiatric disorders (Jeong *et al*., 2019). Moreover, due to high cost of fat, the products containing high fat content relatively costly. Paneer is a protein rich dairy product and fulfills the protein requirement of most vegan people of India. But because of its high cost many people cannot afford it and refrain from consuming it daily. Therefore, efforts have been made to develop reduced-fat/low-fat paneer without adversely affecting its sensory and textural properties. Nowadays food entrepreneurs are show interest towards low-fat products and in India some private entrepreneurs have started manufacturing and marketing low-fat paneer *viz*. Nutrix Gold Agro Pvt. Ltd. (Pune), National Dairy (Mumbai), Sterling Agro Industries Ltd. (Haryana).

Due to the variation in milk production in different seasons, the milk in high production seasons is converted to milk powder and to be used during the lean periods (Khan *et al.,* 2014). During this lean season of milk especially in summer season there is a drastic curtailment in the supply of milk due to reduction in milk production, whereas demand is more during these days. As a result, the price of paneer goes up. To overcome problems regarding variation in the production of milk in different seasons, limited availability of fresh milk in some areas of the world and ultimately affecting the price of fresh milk various techniques have been developed for the production of dairy products using RCM. A few research workers had tried to make products

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from RCM with some modifications in the manufacturing process *viz*. manufacture of Mozzarella cheese from milk powder made by a combination of microfiltration and ultrafiltration (Garem *et al.,* 2000), paneer from RCM of higher TS content (Khan and Pal, 2010), optimized process for paneer from whole milk powder at various reconstitution levels (Khan *et al.,* 2012), an acceptable quality dahi can easily be made from reconstituted and recombined milk (Uddin *et al.,* 2013), development of low-fat khoa utilizing reconstituted skim milk and WPC (Vijaykumar *et al.,* 2020).

MATERIALS AND METHODS

The present research work was conducted in Dairy Technology Department, SMC college of Dairy science, Anand during the period of 2019 to 2021. Sagar brand of Amul skimmed milk powder was used for reconstitution. Fresh cream was used for standardization of RCM fat. Citric acid (edible grade), supplied by Loba-Chemical Pvt. Ltd., Mumbai was used as a coagulant. Reduced-fat paneer from reconstituted milk was prepared in the laboratory using method described by Aneja *et al*. (2002). Reconstituted milk was prepared to 12.0 per cent MSNF using skimmed milk powder and water then keeps it for about 1-2 h for proper hydration of powder and then standardized to 1.5 per cent fat by adding cream. Two kg of product mix as obtained above was then subjected to heat treatment. The milk was held for 5.0 min. at 90°C and subsequently cooled to 70°C. It was then coagulated with citric acid (1.0 per cent solution at 70°C), which was added slowly to the milk with slow stirring until a curd and clear whey separated out. The curd was allowed to settle for 5.0 min and the whey was drained through a muslin cloth. The curd was then collected and filled in a rectangular shaped sterilized stainless steel hoop (15 × 10 × 9 cm^3) lined with a clean muslin cloth. The curd was pressed for 20.0 min. by applying 2.0 kg/cm^2 pressure on it. The pressed block of curd was removed from the hoop and dipped in pasteurized chilled water (4 to 6°C) for 1 h and then wrapped in12 m polyester + 50 m LD/LLDPE laminated pouches and stored at refrigeration temperature (7±2°C).

The fat and TS content in milk was estimated by method described in FSSAI (2016) manual. The moisture content in paneer was determined by according to AOAC (2000). The fat content of paneer samples was determined by the Gerber method as described in IS: 1224-2 (1977). The protein content in paneer was determined by kjeldahl method as per AOAC (1980). The pH of paneer sample was measured using a digital pH meter equipped with glass electrode. About 10.0 g of grated paneer sample was weighed into a 50.0 ml beaker and made into paste by the addition of equal volume of freshly boiled and cooled distilled water. Titratable acidity was determined by the procedure described by Boghra and Rajorhia (1982).

Sensory evaluation of paneer

Each block of paneer was cut into approximately 25.0 g rectangular pieces. The paneer samples were tempered to 15±2°C before judging. In isolated booths illuminated with incandescent light maintained at 23±2°C, sensory analysis of paneer samples was performed. The sensory panel (n=9) was composed of staff members and post graduate students working in the institution. The paneer samples were evaluated using 9 point hedonic scale as described in Indian Standards (IS: 15346, 2003).

Texture profile analysis

Compression testing of paneer samples was done with Lloyd Instrument, Hampshire, UK (Model No. 01/2962) using 5.0 KN load-cells which moved at a speed of 20.0 mm/min. The paneer samples were taken for texture measurement after tempering the same at 23±1°C for h. All the textural measurements were conducted in a room maintained at 23±1°C temperature and 65.0±1.0 per cent RH. Cubic samples of the experimental paneer, with edges of 20.00±0.06 mm, were placed in the compression support plate in such a manner that fibers were oriented perpendicular to the cylindrical compression anvil. The cubic samples were compressed up to 60.0 per cent of their initial size. Five 20.0 mm cubic paneer samples were used for each experimental paneer under study and the average value of these readings was reported.

Statistical analysis

The mean values generated from the analysis of duplicate samples of paneer was subjected to statistical analysis using completely randomized design (Factorial) using software developed by Anand Agricultural University.

RESULTS AND DISCUSSION

Selection of coagulation temperature

Paneer from RCM was prepared according to method given by Aneja *et al.* (2002). Calculated quantity of cream was added to RCM to achieve a final composition of 2.5 per cent fat and 10.0 per cent MSNF. The milk was heated to 90°C for 5 min. and three different temperatures of coagulation were used *viz.* 70 (T1), 75 (T2) and 80°C (T3) for complete coagulation of paneer from RCM.

The data presented in Table 1 show that the coagulation temperatures had significant (P<0.05) effect on moisture, fat, FDM content and yield of paneer. The moisture content and yield of paneer were decreased with increase in coagulation temperatures. Whereas, fat and FDM content was increased. The highest yield was found at coagulation temperature 70°C *i.e*. 15.64 per cent. Yashavantha *et al.* (2020) also reported that coagulation temperature had significant (P<0.05) effect on moisture and FDM content of paneer. Guraddi *et al.* (2016) reported similar results for yield of paneer. Chandan (2007) also reported that the yield of paneer decreases with increase in the coagulation temperature. However, pH, acidity and required quantity of coagulant for paneer were non-significantly (P>0.05) affected by coagulation temperatures. Yashavantha *et al.* (2020) reported same result for paneer.

It can be seen from Table 2 that coagulation temperatures had significant (P<0.05) effect on rheological parameters *viz.* hardness, cohesiveness, springiness, gumminess, chewiness and adhesiveness of paneer. The hardness, gumminess, chewiness and adhesiveness were significantly (P<0.05) increased with increase in coagulation temperature from 70 to 80°C. The high hardness at high coagulation temperature was due to low moisture retention. The cohesiveness and springiness of reduced fat paneer were significantly (P<0.05) decreased with increase in coagulation temperature. Mathare *et al.* (2009) reported that the hardness of soy paneer increased as the coagulation temperature increased from 80-90°C. Dishiwarthani *et al.* (2018) found that hardness and cohesiveness were increased with the coagulation temperature up to 90°C and springiness increased with the temperature up to 80°C then decreased with the increase in coagulation temperature in buffalo milk paneer coagulated with lime juice. Ahmed and Bajwa (2019) concluded that the adhesiveness of the paneer has direct relationship with springiness, gumminess and chewiness that might be influenced by the presence of pectin and other carbohydrates in the protein matrix.

The effect of coagulation temperatures on sensory attributes *i.e.* flavour, body and texture, colour and appearance and overall acceptability of reduced-fat paneer is presented in Table 3 The coagulation temperatures had significant effect (P<0.05) on body and texture and overall acceptability of paneer. The body and texture score consequently overall acceptability score were found higher at coagulation temperature 70°C *i.e.* 7.70. However, there were non-significant (P>0.05) effect of coagulation temperatures found on flavour and colour and appearance score of reduced fat paneer. Hence, coagulation temperature 70°C was selected for manufacture of reduced fat paneer from RCM. Roy and Singh (1994) reported that the effect of coagulation temperature was more noticeable on body and texture of paneer as the coagulation temperature increased, the body of paneer became harder and there was no marked

Table 1: Effect of coagulation temperatures on the various parameters and quantity of citric acid of reduced-fat paneer.

Coagulation temperatures (°C)	Various parameters of RFP*						Quantity of citric acid (g/kg milk)
	Moisture (%)	Fat (%)	FDM (%)	Yield (%)	pH	Acidity (%LA)	
T1 (70)	58.23^{a}±0.94	15.60^{b}±1.75	36.70^{b}±1.03	15.64^{a}±0.15	5.75±0.02	0.39±0.04	2.04±0.12
T2 (75)	55.06^{b}±1.39	16.40^{ab}±0.42	38.68^{ab}±4.62	14.97^{b}±0.30	5.74±0.07	0.41±0.04	2.03±0.10
T3 (80)	54.24^{b}±2.19	17.50^{a}±0.50	41.68^{a}±1.21	14.00^{c}±0.63	5.81±0.12	0.40±0.03	2.02±0.10
SEm	0.71	0.48	1.26	0.18	0.04	0.02	0.05
CD (0.05)	2.20	1.48	3.89	0.57	NS	NS	NS
CV (%)	2.86	6.52	7.22	2.78	1.36	9.03	5.22

Each observation is Mean±SD (n=5); NS- non significant (P>0.05); a-c denote significant difference (P<0.05) in same column.

Table 2: Effect of coagulation temperatures on rheological properties of reduced-fat paneer.

Coagulation temperatures (°C)	Hardness (N)	Cohesive-ness	Springiness (mm)	Gumminess (N)	Chewiness (N mm)	Adhesiveness (N mm)
T1 (70)	30.86^{c}±4.42	0.46^{a}±0.01	7.65^{a}±0.17	10.36^{c}±0.82	75.48^{c}±5.90c	0.08^{b}±0.01
T2 (75)	44.97^{b}±6.90	0.43^{a}±0.02	7.45^{b}±0.15	20.35^{b}±2.28	150.05^{b}±21.72	0.08^{b}±0.02
T3 (80)	68.30^{a}±2.74	0.37^{b}±0.03	7.14^{c}±0.07	31.62^{a}±1.98	242.00^{a}±19.91	0.28^{a}±0.02
SEm	2.23	0.01	0.06	0.81	7.76	0.01
CD (0.05)	6.88	0.03	0.19	2.49	23.91	0.03
CV (%)	10.38	5.23	1.88	8.71	11.13	13.39

Each observation is Mean±SD (n=5); a-c denote significant difference (P<0.05) in same column.

Table 3: Effect of coagulation temperatures on sensory attributes of reduced-fat paneer.

Coagulation temperatures (°C)	Flavour	Body and texture	Colour and appearance	Overall acceptability
T1 (70)	7.60±0.42	7.70^{a}±0.27	7.80±0.27	7.70^{a}±0.27
T2 (75)	7.50±0.35	7.60^{a}±0.22	7.50±0.50	7.60^{a}±0.22
T3 (80)	7.20±0.27	7.10^{b}±0.22	7.40±0.42	7.20^{b}±0.27
SEm	0.16	0.11	0.18	0.12
CD (0.05)	NS	0.33	NS	0.36
CV (%)	4.76	3.23	5.40	3.44

Each observation is Mean±SD (n=5); a-b denote significant difference (P<0.05) in same column; NS- Non significant (P>0.05).

effect on colour and appearance of the paneer. Similar result was also reported by Sachdeva and Singh (1988) and Chandan (2007) that paneer obtained by coagulating milk at 70°C had the best organoleptic quality and had desired frying quality *viz*. integrity/shape retention and softness.

Selection of level of fat and MSNF in reconstituted milk

Paneer was prepared according to the method standardized by Aneja *et al.* (2002). Paneer was prepared from milk standardized to different levels of fat and MSNF *viz*. 1.5, 2.0 and 2.5 per cent fat and 9.0, 10.0, 11.0 and 12.0 per cent MSN respectively. The different treatment combinations (fat: MSNF) in RCM were designated as C1 (1.5:9.0), C2 (1.5:10.0), C3 (1.5:11.0), C4 (1.5:12.0), C5 (2.0:9.0), C6 (2.0:10.0), C7 (2.0:11.0), C8 (2.0:12.0), C9 (2.5:9.0), C10 (2.5:10.0), C11 (2.5:10) and C12 (2.5:12.0) and studied for analysis. The milk was coagulated at 70°C using 1.0 per cent citric acid solution.

The tabulated average mean values in Table 4 reveal that utilization of different levels of fat and MSNF in RCM had significant (P<0.05) effect on yield and TS recovery of reduced-fat paneer. The obvious increase in yield with increase in fat and MSNF was found in paneer. The average mean values of yield of reduced fat paneer were found 12.85 to 17.98 per cent. The TS recovery of paneer significantly (P<0.05) increased with increase in fat content. The average mean values of TS recovery were varying from 49.08 to 58.21 per cent. The interaction between level of fat and MSNF had non-significant (P>0.05) effect on yield of paneer and significant (P<0.05) effect on TS recovery of paneer. Whereas, different levels of fat and MSNF and interaction between them found non-significant (P>0.05) effect on fat recovery of paneer. The average mean values of fat recovery were found 87.03 to 96.40 per cent. The obtained result in this investigation corroborated with Roy (2016) reported yield 13.83 to 15.50 of reduced-fat paneer from cow milk. Garem *et al.* (2000) also revealed that Mozzarella cheese produced by recombination had same composition and properties as control Mozzarella (produced with raw fresh milk), but when the powder was used, the cheese making yields were 7.3±1.8 per cent higher in comparison with the control cheese. Khan *et al.* (2012) reported fat and TS recoveries 95.22, 95.61 per cent and 58.67, 58.85 per cent respectively for paneer prepared from different 1:5 and 1:6 reconstitution levels in milk.

It can be revealed from Table 5 data that levels of fat and MSNF in RCM had a significant (P<0.05) effect on fat and moisture content of paneer. Whereas, MSNF content in RCM had non-significant (P>0.05) effect on protein content of paneer. The fat content in paneer increased with fat in RCM and decreased with increase in MSNF of RCM. Same trend was not found in case of moisture and protein content of paneer. The moisture and protein in paneer were significantly (P<0.05) decreased with increase in fat content of RCM. The interaction between fat and MSNF content of

Table 4: Effect of levels of fat and MSNF on yield and recovery of milk constituents.

Levels of MSNF (%) \ Levels of fat (%)	F1 (1.5)	F2 (2.0)	F3 (2.5)	Average for MSNF
		Yield (%)		
S1 (9.0)	12.85±0.25	13.85±0.15	13.99±0.69	13.56
S2(10.0)	14.20±0.50	15.55±0.20	15.75±0.10	15.17
S3(11.0)	14.65±0.40	15.73±0.53	16.15±0.30	15.51
S4(12.0)	16.38±0.53	17.05±0.45	17.98±0.28	17.13
Average for fat	14.52	15.54	15.97	-
CD (0.05) F=0.339, S=0.391, F×S=NS				
		Fat recovery (%)		
S1(9.0)	87.03±11.55	95.31±0.02	95.32±0.96	92.56
S2(10.0)	93.63±0.04	92.96±2.37	92.76±0.04	93.12
S3(11.0)	93.73±0.05	95.48±0.00	96.40±0.00	95.20
S4(12.0)	93.50±0.03	95.50±0.00	96.35±0.03	95.12
Average for fat	91.97	94.81	95.20	-
CD (0.05) F=NS, S=NS, F×S=NS				
		TS recovery (%)		
S1(9.0)	52.01±0.76	56.59±1.45	54.88±2.34	54.49
S2(10.0)	53.11±0.08	58.21±2.20	54.99±2.00	55.44
S3(11.0)	52.97±0.46	52.22±3.38	52.53±0.69	52.57
S4(12.0)	51.62±1.92	49.08±2.66	55.48±1.78	52.06
Average for fat	52.43	54.02	54.47	-
CD (0.05) F=1.595, S=1.841, F×S=3.189				

Each observation is Mean±SD (n=3); NS- non significant (P>0.05).

RCM had significant (P<0.05) effect on fat, moisture and protein content of reduced-fat paneer. It can be seen from Table 5 that different levels of fat and MSNF of RCM and interaction between them found significant (P<0.05) effect on pH of reduced-fat paneer. Roy (2016) reported the contents of fat and FDM in reduced-fat paneer increased with the increasing fat content in the milk and found 13.06 to 16.76 per cent fat and 31.37 to 31.90 per cent FDM respectively. Dikshit *et al.* (2015) reported that fat content of low-fat paneer decreased as decreasing fat content of milk as 3.0, 2.5, 2.0 and 1.5 per cent and relatively fat content was 14.58, 12.78, 10.62 and 8.93 per cent respectively. The obtained fat content was slightly higher due to higher fat recovery in RCM paneer suggested by Garem *et al.* (2000). Khan *et al.* (2012) reported the moisture content of paneer prepared from 1:5 and 1:6 (WMP: Water) reconstitution levels 57.41 and 57.44 per cent respectively. Pal *et al*. (1991) obtained a protein content *i.e*. 23.60 per cent in paneer prepared from 1.5 per cent mixed milk. The protein content of all the paneer samples of different reconstitution levels 1:2, 1:3, 1:4,1:5 and 1:5 (WMP: Water) including the control did not show any significant difference (P>0.05) up on comparison (Khan *et al.,* 2012). Khan *et al.* (2012) reported the pH of RCM from 1:5 and 1:6 (WMP: Water) reconstitution levels was 5.89.

The obtained data presented in Table 6 expose that different levels of fat per cent significantly (P<0.05) affect flavour, body and texture, colour and appearance and overall acceptability scores of reduced-fat paneer. Similarly, the effect of different levels of MSNF per cent also found significant (P<0.05) effect on flavour, body and texture, colour and appearance and overall acceptability scores of paneer. The effect of interactions between different levels of fat and MSNF per cent in RCM were found non-significant (P>0.05) for all the sensory attributes of reduced-fat paneer. The highest average score for flavour, body and texture, colour and appearance and overall acceptability was found in 1.5 per cent fat and 12.0 per cent MSNF *i.e*. 7.93, 7.63, 8.22 and 7.77 respectively. Khan *et al.* (2012) suggested that in terms of sensory quality, it was

Table 5: Effect of levels of fat and MSNF on compositional attributes and pH of paneer.

Levels of fat (%) / Levels of MSNF (%)	F1 (1.5)	F2 (2.0)	F3 (2.5)	Average for MSNF
		Fat (%)		
S1(9.0)	12.75±0.75	16.13±0.13	17.25±0.25	15.38
S2(10.0)	12.38±0.88	13.88±0.13	16.75±0.25	14.33
S3(11.0)	12.00±0.50	13.25±0.25	16.38±0.13	13.88
S4(12.0)	10.13±0.13	12.50±0.50	16.25±0.25	12.96
Average for fat	11.81	13.94	16.66	-
CD (0.05) F=0.356, S=0.411, F×S=0.712				
		Moisture (%)		
S1(9.0)	57.49±0.83	55.40±0.33	54.91±0.33	55.94
S2(10.0)	56.95±1.57	55.24±1.12	56.50±1.30	56.23
S3(11.0)	55.93±0.62	56.93±1.28	56.21±0.93	56.36
S4(12.0)	57.51±0.29	59.72±1.12	55.32±0.82	57.52
Average for fat	56.97	56.82	55.74	-
CD (0.05) F=0.814, S=0.940, F×S=1.628				
		Protein (%)		
S1(9.0)	23.09±0.31	22.91±0.22	22.20±0.22	22.73
S2(10.0)	24.88±2.46	24.79±1.03	20.54±0.89	23.40
S3(11.0)	27.15±1.25	25.77±3.26	20.63±0.99	24.52
S4(12.0)	26.35±0.36	21.79±0.27	21.75±1.12	23.30
Average for fat	25.37	23.81	21.28	-
CD (0.05) F=1.159, S=NS, F×S=2.317				
		pH		
S1(9.0)	5.79±0.01	5.83±0.03	5.74±0.01	5.79
S2(10.0)	5.74±0.01	5.84±0.01	5.79±0.01	5.79
S3(11.0)	5.73±0.01	5.71±0.01	5.74±0.01	5.72
S4(12.0)	5.73±0.01	5.72±0.01	5.74±0.01	5.73
Average for fat	5.75	5.77	5.75	-
CD (0.05) F=0.010, S=0.012, F×S=0.020				

Each observation is Mean±SD (n=3); NS- Non significant (P>0.05).

Table 6: Effect of levels of fat and MSNF on sensory attributes of paneer.

Levels of MSNF(%) \ Levels of fat(%)	F1 (1.5)	F2 (2.0)	F3 (2.5)	Average for MSNF
		Flavour score		
S1(9.0)	7.23±0.03	7.07±0.12	6.70±0.17	7.00
S2(10.0)	7.53±0.06	7.22±0.03	7.17±0.29	7.31
S3(11.0)	7.77±0.03	7.52±0.03	7.25±0.05	7.51
S4(12.0)	7.93±0.12	7.78±0.03	7.50±0.00	7.74
Average for fat	7.62	7.40	7.15	-
CD (0.05) F=0.094, S=0.109, F×S=NS				
		Body and texture score		
S1(9.0)	7.20±0.05	7.12±0.03	7.03±0.06	7.12
S2(10.0)	7.37±0.06	7.25±0.05	7.12±0.10	7.24
S3(11.0)	7.53±0.06	7.30±0.00	7.15±0.05	7.33
S4(12.0)	7.63±0.15	7.47±0.06	7.22±0.03	7.44
Average for fat	7.43	7.28	7.13	-
CD (0.05) F=0.058, S=0.067, F×S=NS				
		Colour and appearance score		
S1(9.0)	7.78±0.03	7.50±0.00	7.42±0.03	7.57
S2(10.0)	8.00±0.00	7.60±0.00	7.52±0.03	7.71
S3(11.0)	8.10±0.10	7.77±0.06	7.58±0.08	7.82
S4(12.0)	8.22±0.03	7.93±0.12	7.68±0.08	7.94
Average for fat	8.03	7.70	7.55	-
CD (0.05) F=0.050, S=0.057, F×S=NS				
		Overall acceptability score		
S1(9.0)	7.25±0.05	7.13±0.06	7.07±0.06	7.15
S2(10.0)	7.37±0.06	7.20±0.00	7.10±0.10	7.22
S3(11.0)	7.50±0.10	7.40±0.10	7.20±0.00	7.37
S4(12.0)	7.77±0.12	7.60±0.00	7.37±0.06	7.58
Average for fat	7.47	7.33	7.18	-
CD (0.05) F=0.059, S=0.068, F×S=NS				

Each observation is Mean±SD (n=3); NS- Non significant (P>0.05).

possible to manufacture paneer from the RCM at 1:5 and 1:6 (WMP: Water) reconstitution levels and these were very close to control samples. K.V. (2014) reported the highest overall acceptability score 8.00 of paneer prepared from 1:6 (WMP: Water) level and also found significant effect among other samples.

CONCLUSION

The paneer coagulated at temperature 70°C showed better body and higher overall acceptability score than 75 and 80°C. It was found that paneer prepared from 1.5 per cent fat and 12.0 per cent MSNF in milk had significantly (P<0.5) higher overall acceptability score compared to all the other combinations studied. Hence, it is possible to manufacture reduced fat paneer from RCM having 1.5 per cent fat and 12.0 per cent MSNF coagulating at 70°C using 1.0 per citric acid which gave better sensory quality. The quality of manufactured paneer can be further increased by using hydrocolloids or fat replacer like WPC.

Conflict of interest

All authors declare that they have no conflict of interest.

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