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INFLUENCE OF INCORPORATION OF BUTTER MILK CHAKKA ON THE QUALITY OF PROCESSED CHEESE SPREAD

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Abstract: Addition of buttermilk solids in the form of buttermilk chakka (BMCH) to process cheese blend at levels of 0, 10, 15, 20, and 25 percent of cheese solids by weight significantly decreased fat and FDM content as the external fat source was not used in the cheese blend. Significant ($P<0.05$) decrease in salt content, pH, Total volatile fatty acid (TVFA), meltability and fat leakage, however, protein content, acidity, yield, spreadability, colour and appearance and overall acceptability increased significantly. Soluble nitrogen content and flavour score decreased at lower level of incorporation of BMCH solids and subsequently increased where as penetration value increased initially followed by decrease in penetration. A 25% incorporation of BMCH solids to the cheese blend was adjudged best among the levels tried.
Keywords: Buttermilk solids, Chakka, Processed cheese spread, Proximate composition.

Introduction

Processed cheese spreads are the foods prepared by comminuting and mixing several lots of cheeses into a homogenous spreadable mass with the help of heat and with one or more permissible emulsifiers. Various other dairy and non-dairy ingredients are also used to improve certain characteristics *viz.*, spreadability and to reduce production cost. The most commonly used cheeses are Cheddar and Ras (Aly *et al.,* 1995). Most commonly used other dairy ingredients include skimmed milk powder (Shehata *et al.,* 1982 b, Abdel-Baky *et al.,* 1987); whey protein products (Salem *et al.,* 1987, El-Neshawy *et al.,* 1988, Strandholm *et al.,* 1989); buttermilk products (Kairyukshtene and Roudonene 1980, Simov and Prodanski 1982, El Sayed et al, 2010, Doosh et al, 2014), milk solid fermentee and cheese slurry (Tamime *et al.,* 1991, Singh *et al.,* 1993).

The manufacturing of processed cheese spread (PCS) offers several additional advantages over processed cheese such as they are economical, posses the possibilities of satisfying the variable demands of consumers for taste, spreadable at household refrigerator's temperature

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and have flavor of natural cheese. It also permits addition of optional flavoring ingredients such as fruits, spices, herbs etc.

Buttermilk is the byproduct of butter industry and is available in ample in the industry. Also it is an ideal and cheaper food source having similar compositional attributes to skim milk. Though use of buttermilk in many products by several research workers has been reported, documentary evidence of its commercial utilization is missing. Hence, an attempt was made to explore the possibility of utilization of buttermilk solids in the form of buttermilk chakka in manufacturing of processed cheese spread. While planning the experiment, it was pre-conceived that there will be no addition of fat in any form other than the one supplied by the cheese blend itself to meet the legal standards for fat content for PCS i.e. minimum 40 % fat on dry matter.

Materials and Methods

Cheese blend: A cheese blend was prepared by mixing shredded cheese of young [3 to 3.5 month old having 37.19 % moisture, 30.0 % fat, 28.76 % protein, 1.73 % salt, 5.21 pH, 32.60 TVFA and 27.66 RI (ripening index)] and ripened [4 to 5 month old having 36.66 % moisture, 30.50 % fat, 28.35 % protein, 1.81 % salt, 5.26 pH, 44.20 TVFA and 36.26 RI] in 30:70 proportions, based on preliminary investigation.

Sweet cream buttermilk (SCBM): Fresh sweet cream buttermilk [91.42 % moisture, 0.45 % fat, 3.13 % protein and 0.144 % lactic acid] was obtained from Kaira District Co-operative Milk Producers' Union Ltd., Anand.

Buttermilk chakka (BMCH): Buttermilk chakka was prepared by heating fresh sweet cream buttermilk to 85 C for 5 min. and inoculation with starter culture, *Str. lactis* var. *thermophilus* (MD 2) and *Lb. bulgaricus* (LBW) at the rate of 1 % each. It was incubated at 42 C to get 0.9 % lactic acid and partial draining of whey by tying in muslin cloth for 4 to 5 h. Chakka so obtained had 80.16 % moisture, 1.1 % fat, 12.96 % protein, 3.35 % soluble nitrogen and 1.80 % lactic acid.

Emulsifying salts and preservatives: Emulsifying salts was a combination of tri-sodium citrate and di-sodium phosphate (both from Samir Tech-Chem Industry Baroda) in 2:1 proportion (Dholu, 1989). The rate of addition was 2.5 % (w/w) of the final PCS. Sorbic acid was used as preservative and was added at the rate of 0.1 % (w/w) of the blend.

Processed cheese spread preparation: PCS were prepared by blending calculated amount of shredded young and ripened cheeses. In the experimental PCS preparation buttermilk solids in the form of BMCH were incorporated to replace the cheese total solids by

buttermilk solids at 0, 10, 15, 20 and 25 percent levels. PCS samples were prepared using one kg of cheese blend at laboratory scale. Emulsifiers were dissolved in sufficient quantity of calculated amount of water and added after melting of the cheese blend. Blends were processed as per Dholu *et al.,* (1994).

Analysis of processed cheese spread: The PCS samples were analyzed for moisture (Laboratory Manual, 1959), fat (Manual for Dairy Chemistry, 1972), soluble nitrogen (Kosikowski, 1970), TVFA (Kosikowski and Dahlberg, 1946), protein (Jayaraman, 1981), consistency (as penetration value) using Universal Cone Penetrometer (Hartman, 1976), meltability (Olson and Price, 1958) and fat leakage (DeMan and Wood, 1959).

Panel of judges, selected from the faculty who were familiarized with the quality of the processed cheese spread, carried out sensory evaluation, for the samples using nine point hedonic scales. Data were analyzed using a completely randomized design (Steel and Torrie, 1980).

Results and discussion

Composition: The data presented in Table-1 represent the influence of incorporation of buttermilk chakka on the compositional attributes of processed cheese spread. Average moisture contents ranged from 58.43 (L0) to 59.31 % (L4) were statistically at par and well within the limits prescribed by BIS. The fat content of PCS samples, which ranged from 16.38 to 19.96 percent showed statistically significant reduction in the fat content at higher incorporation levels of buttermilk chakka solids. Like the fat content FDM content also showed reducing trend and all the samples differed significantly from each other. The reducing trend seen in the study is because of non-addition of external source of fat. Abdel-Baky *et al.,* (1987) and El-Neshawy et al (1987) reported similar values for FDM content.

Protein content of the PCS samples increased from 18.52 to 19.88 %. The control (L0) sample had the least value and was significantly lower compared to the experimental PCS samples. Incremental addition of buttermilk chakka solids resulted in increase in protein content however significant difference was noted only at higher level of incorporations. El-Neshawy et al (1987) and Dholu (1989) reported similar trend for the protein content.

Table-1: Effect of incorporation of buttermilk chakka solids on compositional attributes of processed cheese spread

(%) Level of Incorporation	Compositional attributes (%)				
	Moisture	Fat	FDM	Protein	Salt
L_0 (0)	58.43[a]	19.96[a]	48.02[a]	18.52[a]	1.31[a]
L_1 (10)	59.11[a]	18.56[b]	45.39[b]	19.03[b]	1.25[b]
L_2 (15)	59.18[a]	18.00[b]	44.09[b]	19.35[b]	1.20[b]
L_3 (20)	59.16[a]	17.13[b]	41.94[b]	19.67[b]	1.16[b]
L_4 (25)	59.31[a]	16.38[b]	40.26[b]	19.88[b]	1.12[b]
CD (P<0.05)	ns	0.58	0.69	0.35	0.024

The values in each column having a common alphabetical superscript are statistically (P<0.05) alike/ identical.

Salt content of the PCS samples ranged from 1.12 to 1.31 % and showed significant reduction at each level of incorporation of buttermilk chakka solids. Since BMCH did not contain any salt and as salt was not added externally, the significant reduction in the content noted was obvious.

The data presented in Table-2 depicts the influence of incorporation of buttermilk chakka solids on physico-chemical attributes of PCS. The average values for acidity, which ranged from 0.98 % lactic acid, being the lowest for (L0), and was significantly lower, to 1.47 % lactic acid (L4). Progressive incorporation of buttermilk chakka solids, by 10 or more %, resulted in significant increase in acidity of the experimental samples. The increase in acidity was because of higher lactic acid content of BMCH and with progressive incorporation of the same resulted in the observed effect.

The pH of PCS samples varied from 5.57 (L4) to 5.96 (L0), being the highest value, and significantly different from the rest of the samples, for control sample. Progressive incorporation of BMCH to PCS blend showed significant reduction in pH, however, successive incorporation failed to show significant effect. Similar trends were reported by Shehata *et al.,* (1982 a), Abdel-Baky *et al.,* (1987) and El-Neshawy *et al.* (1987).

The mean values for percent soluble nitrogen content of PCS samples ranged from 1.45 (L1) to 1.59 (L0). Sample L0 differed significantly from the L1 sample having least incorporation of BMCH. All the experimental samples viz. L1 to L4 were alike in their soluble nitrogen content leading to conclude that incorporation of BMCH at four different levels failed to produce significant effect on soluble nitrogen content; however, marginal increase in the content was noted.

The average Total Volatile Fatty Acids (TVFA) content varied from 30.75 (L4) to 41.75 ml (L0) being the control sample had significantly higher value than the experimental samples. Successive incorporation of BMCH showed significant reduction in TVFA. El-Neshawy *et al.,* (1987) reported even higher values for TVFA, however, values for TVFA reported by Abdel-Baky *et al.,* (1987) and Magdoub *et al.,*(1984 b) were similar.

Table-2: Effect of incorporation of buttermilk chakka solids on physico-chemical attributes of PCS.

(%) Level of Incorporation	Physico-chemical attributes			
	Acidity (a)	pH	Soluble nitrogen (%)	TVFA (b)
L_0 (0)	0.98^{a}	5.96^{a}	1.59^{a}	41.75^{a}
L_1 (10)	1.35^{b}	5.75^{b}	1.45^{b}	37.75^{b}
L_2 (15)	$1.39^{b,c}$	5.68^{b}	1.48^{b}	36.50^{b}
L_3 (20)	$1.43^{c,d}$	5.62^{b}	1.50^{b}	34.00^{b}
L_4 (25)	1.47^{d}	5.57^{b}	1.51^{a}	30.75^{b}
CD (P<0.05)	0.05	0.12	0.08	2.18

(a) % lactic acid
(b) ml of 0.1 N NaOH per 100 g of cheese
(c) The values in each column having a common alphabetical superscript are statistically (P<0.05) alike/ identical.

Rheological attributes: Effect of incorporation of BMCH on rheological properties of processed cheese spread is shown in Table-3. Average values for penetration measured at 7 C ranged from 23.68 (L4) to 27.23 mm (L1). Incorporation of BMCH at lower levels i.e. at 10, 15 % did not show significant increase in penetration value, however, higher levels i.e. 20, 25 % showed significant decrease on successive incorporation of BMCH even though they were statistically at par with control (L0) sample. The reduction in penetration value might be ascribed to the effect of pH, which decreased significantly (Table-2) with successive increase in the level of incorporation of BMCH. It is an established fact that a decrease in pH causes a reduction in the water holding capacity of casein micelles making them more compact. Softness of Processed cheese spread is governed by pH and hence penetration property (Fukui *et al.,* 1972, Meyer 1973).

Meltability of the processed cheese spread decreased significantly on successive incorporation of BMCH from 134.25 mm (L0) to 48.00 mm (L4). The reduced meltability of the experimental samples may be ascribed to their reduced fat content, increased protein

content, lower pH and lower soluble nitrogen content (Arnott *et al.,* 1957, Olson *et al.,* 1958, Olson and price 1961 and Vakaleris *et al.,* 1962).

Table-3: Effect of incorporation of buttermilk chakka solids on rheological attributes and yield of PCS

(%) Level of Incorporation	Yield and rheological attributes			
	Penetration value (mm)	Meltability (mm)	Fat leakage (%)	Yield, kg PCS/kg cheese
L_0 (0)	$25.65^{a,b,c}$	134.25^{a}	2.22^{a}	1.60^{a}
L_1 (10)	27.23^{b}	99.25^{b}	$2.05^{a,b}$	1.80^{b}
L_2 (15)	$26.05^{b,c}$	85.00^{c}	$1.97^{a,b}$	1.88^{c}
L_3 (20)	$24.70^{a,c}$	62.00^{d}	1.91^{b}	1.98^{d}
L_4 (25)	23.68^{a}	48.00^{e}	1.87^{b}	2.06^{e}
CD (P<0.05)	2.02	13.33	0.21	0.033

The values in each column having a common alphabetical superscript are statistically (P<0.05) alike/ identical.

The mean value for fat leakage decreased from 2.22 (L0) to 1.87 (L4) and the decrease was nonsignificant at each successive level of incorporation of BMCH. The decrease was significant only at more than 10 percent of incorporation of BMCH.

The data presented in Table-3 reveal that incorporation of BMCH solids to PCS blend resulted in significant increase in yield of PCS per kg cheese blend, however they were at par with the expected yield of PCS as moisture content was pre-decided and based on that requisite calculated quantity of water was added. Successive significant increase in yield was because of more of the total solids brought in by incorporation of buttermilk solids in the blend.

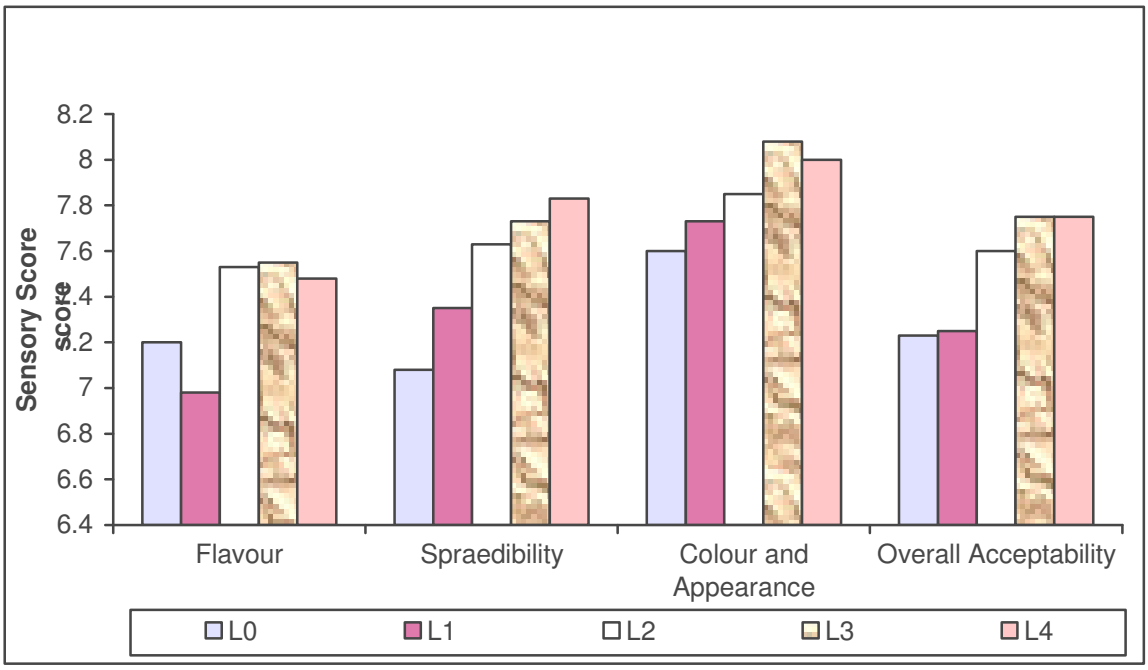

Figure 1 Effect of addition of buttermilk chakka solids at different levels on sensory of PCS

Sensory evaluation: The data presented in Table-4 and Figure 1depicts the influence of incorporation of BMCH solids on sensory profile of processed cheese spread. Non-significant increase in flavour score was observed, however, at higher level of incorporation i.e. at 25 percent it decreased non-significantly. This could be due to increased proportion of less flavorful component i.e. chakka in the blend. This is further substantiated by a reduction in the TVFA contents of the PCS with the increase in the proportion of BMCH in the blend as can be seen from the values presented in Table 2.

Spreadability of the experimental samples increased on incremental incorporation of BMCH solids. The significant increase was evident only at more than 10 percent of incorporation of buttermilk solids (Figure 1).

Incorporation of BMCH solids had significant effect on colour and appearance score of experimental samples. It increased from 7.63 (L0) to 8.08 (L3) and the increase was significant on progressive incorporation, however, 20 and 25 percent levels were statistically at par.

Overall acceptability score varied from 7.23 (L0) to 7.75 (L3, L4) and had significant influence of incorporation of BMCH solids on PCS. At higher levels i.e. 20 and 25 % of addition showed significant increase over (L0) control sample, however, at lower levels i.e. 10 and 15 % of addition showed non-significant increase.

Table-4: Effect of incorporation of buttermilk chakka solids on sensory attributes of PCS

(%) Level of Incorporation	Sensory attributes			
	Flavour	Spreadability	Colour and appearance	Over all acceptability
L_0 (0)	7.20^{a}	7.08^{a}	7.64^{a}	7.23^{a}
L_1 (10)	6.98^{a}	$7.35^{a,b}$	$7.73^{a,b}$	$7.25^{a,b}$
L_2 (15)	7.53^{a}	$7.63^{b,c}$	7.85^{b}	$7.60^{a,b,c}$
L_3 (20)	7.55^{a}	$7.73^{b,c}$	8.08^{c}	7.75^{c}
L_4 (25)	7.48^{a}	7.83^{c}	$8.00^{b,c}$	7.75^{c}
CD (P<0.05)	ns	0.44	0.19	0.40

The values in each column having a common alphabetical superscript are statistically (P<0.05) alike/ identical.

Addition of BMCH solids to PCS blend had no influence on flavour score of PCS. Other attributes viz. fat, FDM, salt, pH, TVFA, meltability and fat leakage decreased, however, protein content, acidity and yield of the processed cheese spread per kg cheese blend, Spreadability, color and appearance and over all acceptability of the experimental samples increased. The soluble nitrogen content first decreased and then increased while penetration value first increased and then decreased.

Conclusion

Thus incorporation of BMCH solids in PCS resulted in significant improvement of sensory profile. Twenty and twenty five percent of buttermilk solids when added, were best among all the experimental samples and they were rated statistically at par too. Hence a higher side of addition, i.e. 25.0 percent of incorporation of buttermilk solids, in the form of BMCH is recommended.

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