Journal of Food Processing & Technology
ISSN: 2157-7110

Rafiq and Ghosh, J Food Process Technol 2017, 8:8
DOI: 10.4172/2157-7110.1000690

Research Article Open Access

Effect of Peanut Addition on the Fatty Acid Profile and Rheological Properties of Processed Cheese

Rafiq SM* and Ghosh BC

ICAR (Indian Council of Agricultural Research), National Dairy Research Institute (SRS), Bengaluru, India

Abstract

The aim of the present study was to increase the unsaturated fatty acid content of the processed cheese by adding peanuts. Processed cheese was prepared from a blend of young and old Cheddar cheese. Partially roasted peanuts were added in form of paste at a level of 5%, 10% and 15%. Fatty acid analysis by gas chromatography showed that peanut added cheeses were characterized by a reduced level of saturated fatty acids (SFA=57.37% to 64.19%) and increased level of polyunsaturated fatty acids (PUFA=5.64% to 10.71%) compared to the control processed cheese (SFA=67.18%; PUFA=2.73%). Addition of peanuts upto 10% had no significant effect ($p>0.05$) on the rheological properties, meltability and sensory properties of processed cheese however at 15% addition all these properties were significantly ($p<0.05$) influenced. Our results suggest that processed cheese fatty acid profile can be improved by adding peanuts up to a level of 10% without affecting its quality attributes.

Keywords: Processed cheese; Fatty acid profile; Peanuts; Gas chromatography; Texture profile analysis; Meltability

Introduction

Processed cheese (PC) is a rich source of fat containing about 40% on dry matter basis and most of the fat is saturated. This saturated fat content in cheese and other dairy products has been associated with cardiovascular diseases. Milk and dairy products with a healthier fatty acid profile and/or more functional or nutraceutical properties has prompted researchers worldwide to evaluate different methods for increasing the level of polyunsaturated fatty acids (PUFAs) in the milk and dairy products of various ruminant species [1]. Several scientists have worked on enhancing the fatty acid profile of milk or milk products by supplementation of unsaturated fatty acids through feed and fortification of dairy products with oils high in PUFAs [2].

Peanuts (*Arachis hypogaea*) containing high unsaturated fatty acid have drawn the attention of manufacturers to be used as an ingredient in various foods as they are inexpensive and nutritionally powerful [3]. Peanuts are rich in protein, oil and fibers [4]. All these components are present in their most beneficial forms. This plant protein, unsaturated fat and complex fiber in peanut are proved to be very good for human nutrition. Peanut fat profile contains about 50% monounsaturated fatty acids (MUFAs), 33% Polyunsaturated fatty acids (PUFAs) and 14% saturated fatty acids which is a heart friendly combination of fatty acids [5]. Consumption of peanuts elicits several biological effects such as weight-loss [6], prevention of cardiovascular diseases by lowering blood pressure and blood cholesterol levels [7], anti-inflammatory effects [8], and inhibition of cancer [9]. Peanut milk has been used in the preparation of yogurt [10] and cheese spread [11] but peanut addition in processed cheese to enhance the fatty acid profile has not been reported. Therefore, an attempt has been made to add peanuts into the processed cheese for a healthier fatty acid profile and to improve its functional value. Addition of peanuts might alter the rheological and sensory properties of processed cheese. Hence, the objective of this study was to identify the optimum level of peanut addition into the processed cheese without affecting its overall quality and to report how best the fatty acid profile of the processed cheese can be improved.

Materials and Methods

Materials

Cheddar cheese, both young (1 to 2 months ripened) and old varieties (6 months ripened) were obtained from the dairy plant of NDRI Bengaluru. Peanuts and common salt were purchased from the local market of Bengaluru. Tri-sodium citrate was used as emulsifying salt for PC preparation.

Manufacture of processed cheese

A blend of Cheddar cheese (75% young and 25% old) was used for PC preparation. The young and old Cheddar cheeses were cleaned, quartered, and milled by using milling machine (WFC and Company USA: Model no 32). Double jacketed steam kettle with a capacity of 10 Kg (Milkmax Engineers, Bengaluru) was used for manufacture of PC. Milled cheese was taken into cheese processing kettle. Calculated amount of salt (1%) and tri-sodium citrate (3%) were dissolved into required amount of hot water and added into the cheese intermittently 2 to 3 times while heating. When the mass became homogeneous, peanut paste was added and mixed thoroughly. Peanut paste was prepared by roasting, peeling and grinding it in a mixer/grinder and the ground peanuts (0%, 5%, 10% and 15%) were mixed with 30% to 40% water to make paste. The mixture of cheese and peanuts were heated to 75°C to 85°C for 5 to 6 minutes with continuous stirring and scraping with a steel ladle. Thereafter, the heating was stopped and the hot product was transferred into moulds, cooled for 2 to 3 hrs at room temperature, packed and stored at refrigeration temperature till its further use.

Compositional analysis

Moisture content of the PC was determined by gravimetric method [12]. Fat content, tritable acidity and ash content were determined as per the method described in AOAC [13]. Total protein was determined by micro kjeldhal method according to AOAC with some modification. The pH of cheese was measured as described by Awad et al. [14].

***Corresponding author:** Rafiq SM, ICAR (Indian Council of Agricultural Research), National Dairy Research Institute (SRS), Adugodi, Bengaluru-560030, India, Tel: 080-25710661; E-mail: mansharafiq@gmail.com

Received July 21, 2017; **Accepted** August 09, 2017; **Published** August 16, 2017

Citation: Rafiq SM, Ghosh BC (2017) Effect of Peanut Addition on the Fatty Acid Profile and Rheological Properties of Processed Cheese. J Food Process Technol 8: 690. doi: 10.4172/2157-7110.1000690

Carbohydrate content was reported by difference method i.e. hundred minus total content of protein, ash, moisture and fat.

Fatty acid analysis

Fatty acids were analyzed using gas chromatography (GC) as per the procedure of O'Fallon et al. [15] with some modifications.

Sample preparation (FAME Synthesis)

Samples (500 mg) were placed into a 16 mm × 125 mm screw-cap Pyrex culture tube (capacity 15 ml) to which 1 ml of the C13: 0 (tridecanoic acid) as internal standard (0.5 mg of C13: 0/ml of methanol), 0.7 ml of 10 N KOH in water, and 5.3 ml of methanol were added. The tube was incubated at 55°C in water bath for 1.5 h with intermittent vigorous shaking for 5 secs at every 20-min interval to properly permeate, dissolve, and hydrolyze the sample. After cooling below room temperature under cold tap water, 0.58 ml of 24 N H_2SO_4 was added to it. The tube was mixed by inversion and incubated again in water bath at 55°C for 1.5 h with intermittent vigorous shaking for 5 secs at every 20-min interval. Thus, fatty acid methyl ester (FAME) synthesis in the tube was cooled in a cold tap water bath. Three milliliters of hexane were added, and the tube was vortex-mixed for 5 min on a multi tube vortex. The tube was centrifuged for 5 min in a tabletop centrifuge, and the hexane layer, containing the FAME was used for fatty acid analysis in GC.

Gas chromatography

The fatty acid composition of the FAME was determined using GC unit (M/s Agilent Technologies, USA, serial No-7890A) equipped with flame ionization detector and a HP-88 capillary column (100 m × 0.25 mm × 0.20 µm). The carrier gas was hydrogen (1.7 ml/min) and the sample volume was 1 µl. The split ratio was 50:1. The injector and the detector were set at 280°C and 250°C respectively. Identification of fatty acids was achieved by comparing the retention times of the peaks with previously run pure standard compounds (Supelco 37 component FAME Mix). Fatty acids were expressed as % of total fatty acids identified in the samples.

Texture profile analysis

Textural properties of the processed cheese were assessed using a TA.XT.plus texture analyzer (Stable Micro Systems Ltd., Godalming, UK). The samples were cut (2.0 cm × 2.0 cm × 2.0 cm) using a stainless-steel knife and measurements were performed by two sequential compression events using a 75-mm compression platen probe at a speed of 2 mm/s and a trigger force of 2 g. Each sample was subjected to 50% compression after tempering the samples for 45 minutes at 25°C ± 2°C. The TPA hardness, cohesiveness, gumminess, adhesiveness, chewiness and springiness were measured [16].

Meltability

Meltability was measured using a modified Schreiber test [17]. Cheese discs (16 mm diameter and 10 mm thickness) were placed in centre of covered glass Petri dishes and kept in a pre-heated oven at 150°C for 5 minutes, after which they were removed and cooled for 30 minutes. Spread area was measured using Image J software and meltability was expressed as a ratio of melted area and initial area.

Sensory analysis

Sensory analysis was performed according to the methodology described by Meyer [18] on a 20-point score card using 8 trained panellists. The sensory panel was selected based on the normal sensitivity for basic color/appearance, body/texture and flavor of cheese. Sensory panelists were well trained on evaluation of processed cheese and were made familiar with the test methods used. Duo-trio tests were used to determine a candidate's ability to detect differences among similar products with different ingredients. Cheese slices (about 2 cm to 3 cm) of 10 g to 15 g of each were presented in a covered glass petri plate in a random order with coded numbers. During each session of evaluation, three samples were presented at a time along with one reference (control) sample. The judged parameters were: appearance (4), body and texture (8) and flavour (8).

Statistical analysis

The statistical analysis was executed using the statistical software SPSS 16.0 (Stat Soft Polska Sp. z o. o., Kraków, Poland). One-way analysis of variance (ANOVA) was performed and significant differences among samples were reported according to Duncan's test at $p<0.05$.

Results and Discussion

Compositional analysis

It was observed that with the addition of peanut into the processed cheese, moisture content increased however, the increase in moisture content was nonsignificant ($p>0.05$) as compared to the control (Table 1). A significant increase in the fat content was observed at 10% and 15% peanut addition whereas at 5% addition no significant difference ($p>0.05$) was found as compared to control. The increase in fat content may be due to the higher level of peanut addition as the oil content in peanut is about 48% to 50% [4]. A significant difference ($p>0.05$) was found in the protein content at 15% addition. Ash content also decreased and was significantly lower in all the cheeses ($p<0.05$) than the control. Carbohydrate content increased with peanut addition and it was significantly higher ($p<0.05$) at 10 and 15% peanut addition. The pH value increased and the acidity decreased with the increased level of peanut addition but no significant difference ($p>0.05$) was found as compared to control.

Fatty acid composition

Fatty acid profile chromatograms of the peanuts, control processed cheese and peanut added processed cheese are shown in Figure 1. The fatty acids were identified based on retention times obtained using Supelco 37 component FAME mix as standard and tridecanoic acid (C13: 0) as an internal standard. The retention time of the standard and fatty acid compositions of peanut, processed cheese and processed cheese with added peanuts are presented in Figure 2. The saturated fatty acids butyric (C4: 0), caproic (C6: 0), caprylic (C8: 0), capric (C10: 0) and lauric acid (C12: 0) were not detected in peanuts whereas in processed cheese the level of these fatty acids ranged from 1.22% to 3.57%. The

Attributes	Control PC	Peanut added PC		
		5%	10%	15%
Moisture (%)	40.95 ± 1.75^{a}	40.94 ± 1.48^{a}	42.29 ± 0.22^{a}	42.50 ± 1.63^{a}
Fat (%)	30.26 ± 0.42^{b}	31.35 ± 0.49^{ab}	31.82 ± 0.83^{a}	32.21 ± 0.60^{a}
Protein (%)	21.82 ± 0.64^{a}	19.79 ± 0.68^{ab}	19.46 ± 01.08^{ab}	18.89 ± 0.98^{b}
Ash (%)	4.03 ± 0.05^{a}	3.78 ± 0.03^{b}	3.74 ± 0.03^{b}	3.87 ± 0.06^{c}
Carbohydrate (%)	0.84 ± 0.35^{b}	1.32 ± 0.31^{ab}	1.58 ± 0.42^{a}	1.90 ± 0.24^{a}
pH	5.34 ± 0.10^{a}	5.38 ± 0.11^{a}	5.41 ± 0.10^{a}	5.44 ± 0.10^{a}
Acidity (% lactic acid)	1.24 ± 0.11^{a}	1.03 ± 0.29^{a}	0.96 ± 0.25^{a}	0.87 ± 0.26^{a}
Results are expressed as Mean ± S.D; means with different superscripts in a row differ significantly ($p<0.05$) (n=3).				

Table 1: Proximate composition of control and peanut added processed cheeses.

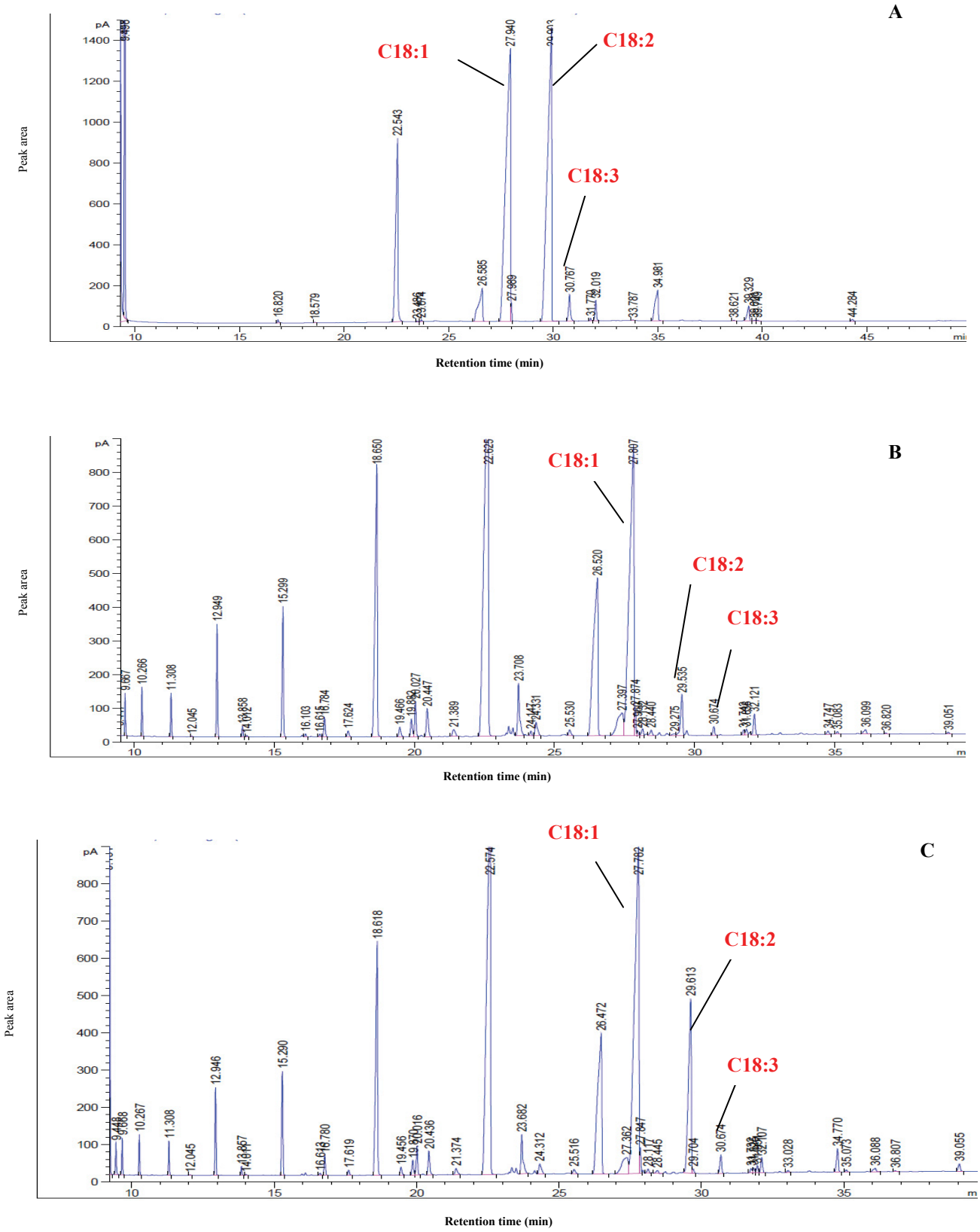

Figure 1: GC-chromatograms of fatty acid profiles. (A) Peanuts, (B) Control processed cheese, (C) 10% peanut added processed cheese.

Fatty acids (%)		Retention time of standard (min)		Control PC	Peanuts	Peanut added PC 5%	Peanut added PC 10%	Peanut added PC 15%
Butyric acid	C4:0	9.665	mean	1.41^{a}	nd	1.40^{a}	1.14^{b}	1.05^{b}
			SD	0.27		0.06	0.01	0.07
Caproic acid	C6:0	10.265	mean	1.55^{a}	nd	1.29^{ab}	1.13^{b}	1.10^{b}
			SD	0.42		0.06	0.05	0.17
Caprylic acid	C8:0	11.305	mean	1.22^{a}	nd	1.01^{ab}	0.84^{b}	0.75^{b}
			SD	0.30		0.10	0.11	0.05
Capric acid	C10:0	12.938	mean	3.04^{a}	nd	2.44^{ab}	2.13^{b}	2.13^{b}
			SD	0.52		0.07	0.42	0.30
Lauric acid	C12:0	15.272	mean	3.57^{a}	nd	3.17^{a}	3.04^{a}	2.96^{a}
			SD	0.22		0.04	0.19	0.67
Myristic acid	C14:0	18.534	mean	11.85^{a}	0.05^{f}	10.76^{b}	9.69^{c}	8.76^{e}
			SD	0.27	0.00	0.49	0.62	0.67
Palmitic acid	C16:0	22.310	mean	29.70^{a}	9.91^{c}	29.52^{a}	27.36^{b}	25.99^{b}
			SD	1.07	0.18	0.64	1.27	0.57
Palmitoleic acid	C16:1	23.634	mean	1.49^{a}	0.18^{b}	1.44^{a}	1.47^{a}	1.26^{a}
			SD	0.45	0.00	0.04	0.06	0.30
Stearic acid	C18:0	26.242	mean	13.25^{a}	4.73^{c}	12.26^{ab}	11.15^{b}	10.99^{b}
			SD	0.34	0.31	0.89	0.87	0.90
Oleic acid	C18:1	27.480	mean	23.09^{c}	37.97^{a}	24.82^{c}	25.46^{bc}	28.64^{b}
			SD	0.18	1.81	0.96	0.49	3.65
	C18:1*trans*	27.060	mean	3.15^{a}	nd	2.60^{ab}	2.26^{ab}	2.11^{b}
			SD	0.47		0.23	0.32	0.49
Linoleic acid	C18:2	29.432	mean	2.15^{e}	32.82^{a}	5.03^{d}	7.92^{c}	10.83^{b}
			SD	0.35	0.54	0.08	0.19	2.17
	C18:2 *trans*	28.421	mean	0.24^{a}	nd	0.17^{a}	0.16^{a}	0.14^{a}
			SD	0.08		0.03	0.05	0.05
Linolenic acid	C18:3	30.619	mean	0.18^{b}	4.75^{a}	0.18^{b}	0.25^{b}	0.35^{b}
			SD	0.06	0.55	0.01	0.02	0.06
	C18:3 *trans*	31.699	mean	0.22^{a}	nd	0.19^{a}	0.17^{a}	0.14^{b}
			SD	0.04		0.02	0.03	0.02
Arachidic acid	C20:0	30.861	mean	0.72^{c}	1.87^{a}	0.77^{c}	0.85^{bc}	0.99^{b}
			SD	0.02	0.10	0.05	0.07	0.17
Eicosenoic acid	C20:1	31.906	mean	0.80^{bc}	1.87^{a}	0.73^{c}	0.88^{bc}	1.01^{b}
			SD	0.06	0.10	0.11	0.07	0.21
Arachidonic acid	C20:4	36.069	mean	0.12^{a}	nd	0.08^{b}	0.07^{b}	0.06^{b}
			SD	0.00		0.02	0.03	0.02
	C22:0+C20:3	34.730	mean	nd	2.99^{a}	0.49^{c}	0.95^{b}	1.23^{b}
			SD		0.81	0.08	0.20	0.60
Lingoceric acid	C24:0	39.050	mean	nd	1.60^{a}	0.07^{c}	0.20^{b}	0.34^{b}
			SD		0.23	0.00	0.06	0.10
Saturated fatty acids SFA			mean	67.18^{a}	18.51^{e}	64.19^{b}	60.37^{c}	57.37^{d}
			SD	0.35	1.04	0.98	0.84	0.95
Monounsaturated fatty acids MUFA			mean	30.47^{b}	40.68^{a}	30.57^{b}	30.86^{b}	31.62^{b}
			SD	0.68	0.91	1.06	0.66	1.28
Polyunsaturated fatty acids PUFA			mean	2.73^{e}	40.09^{a}	5.64^{d}	8.73^{c}	10.71^{b}
			SD	0.35	0.57	0.39	0.75	0.96

Figure 2: Figure displaying fatty acid composition of control processed cheese, peanuts and peanut added processed cheeses (% of total fatty acids, wt/wt).

main contributing saturated fatty acids in processed cheese were found to be palmitic (29.70%), stearic (13.25%) and myristic (11.85%) acids. Palmitic (9.91%) and stearic (4.73%) acid contents of peanuts were significantly lower ($p<0.05$) than the processed cheese while myristic (0.05) acid was present in traces. Palmitic acid has been found to raise serum cholesterol levels. Dietary saturated fat intake has been shown to increase low-density lipoprotein (LDL) cholesterol, and it has been associated with increased risk of cardiovascular disease (CVD). This evidence, coupled with inferences from epidemiologic studies and clinical trials, has led to long standing public health recommendations for limiting saturated fat intake as a means of preventing CVD [19].

Among unsaturated fatty acids peanuts showed significantly higher ($p<0.05$) levels of oleic (37.97%), linoleic (32.82%) and linolenic (4.75%) acids than the control processed cheese (oleic acid=23.09%; linoleic=2.15%; linolenic=0.18%). The oleic acid content of peanuts was similar whereas linoleic acid was slightly lower and linolenic acid was higher than as reported by Maguire et al. [20]. However, the oleic acid content was far lower than as reported by Andersen et al. [21]. The difference in fatty acid profiles may be due to the variety or geographic location. The oleic acid, linoleic and linolenic acid contents of the processed cheese were found to be consistent with those as reported by Kim et al. [22] for different processed cheese varieties. With the addition of peanuts into the processed cheese the levels of these unsaturated fatty acids increased. Increasing the percentage of long-chain, mono- and polyunsaturated fatty acids in milk products is an interesting approach to produce healthier food because these fatty acids are linked to a reduction in the incidence of coronary heart disease in conjunction with an increase in high-density cholesterol

(HDL) [23]. Oleic acid content of control processed cheese increased significantly ($p<0.05$) to 28.64% at 15% peanut addition however, at 5 and 10% peanut addition no significant difference ($p>0.05$) was found as compared to the control. Linoleic acid content was found to be significantly higher ($p<0.05$) than the control processed cheese at all levels of peanut addition. Linolenic acid content also increased but no significant difference ($p>0.05$) found as compared to the control. Trans fatty acids decreased with the addition of peanuts into the processed cheese and at 15% peanut addition trans C18: 1 and trans C18: 3 fatty acids were significantly lower ($p<0.05$) as compared to the control. Trans fatty acids in the diet show a similar action to that of saturated fatty acids, making them potentially hazardous to the organism, especially with respect to coronary diseases [24].

Among other fatty acids detected, the saturated arachidic (C20:0) and unsaturated eicosenoic (C20:1) acid were present in processed cheese in lower quantity whereas in peanuts these were present relatively at a higher level of 1.87%. Addition of peanuts upto 10% had no significant influence on the arachidic (C20:0) and eicosenoic (C20:1) acid contents of the processed cheese but at 15% peanut addition these fatty acids were significantly higher ($p<0.05$) than the control. Arachidonic acid (C20:4n6) was not detected in peanuts however it was present in small quantity in processed cheese. C22:0+C20:3 and lingoceric acid (C24:0) were not found in processed cheese but these acids were detected in peanuts added cheeses in small quantity which might be due to the addition of peanuts into the processed cheese as these fatty acids are present at a higher level of 2.99 and 1.60 respectively in peanuts.

In general, with the addition of peanuts into the processed cheese the level of saturated fatty acids decreased. Conversely, the levels of polyunsaturated fatty acids increased linearly with increased level of peanuts. Monounsaturated fatty acids increased but no significant difference ($p>0.05$) was found as compared to the control. The saturated fatty acid content of the processed cheese (SFA=67.18%) decreased significantly ($p<0.05$) to 64.19%, 60.37% and 57.37% and polyunsaturated fatty acids content (PUFA=2.73%) increased significantly ($p<0.05$) to 5.64%, 8.73% and 10.71% at 5, 10 and 15% peanut addition, respectively.

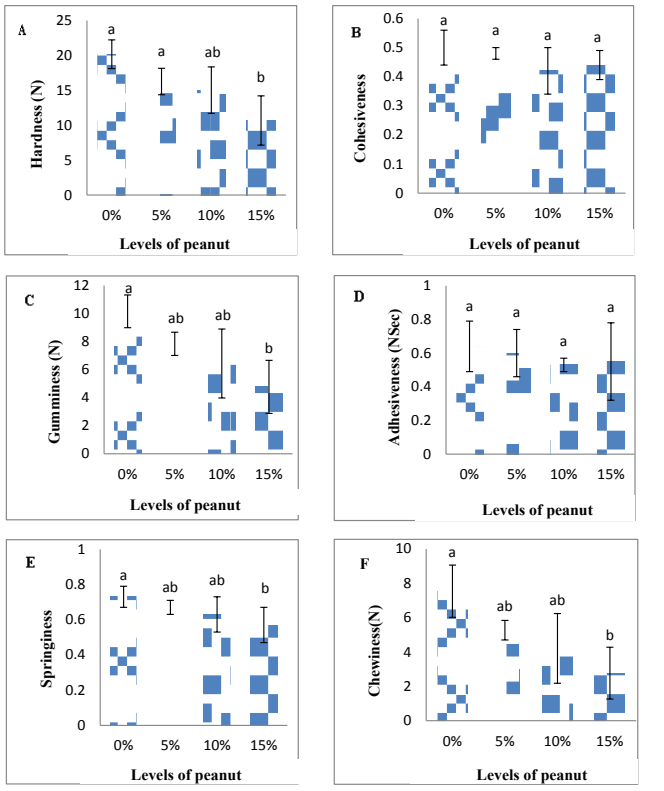

Figure 3: Effect of peanut addition on the textural properties of processed cheese A: Hardness; B: Cohesiveness; C: Gumminess; D: Adhesiveness; E: Springiness; F: Chewiness.

Evaluation of the texture profile

Addition of peanuts up to 10% did not show any significant influence on the textural properties of processed cheese (Figure 3). However, hardness (10.68 N) and gumminess (4.77 N) at 15% peanut addition were found to be significantly ($p<0.05$) lower than the hardness (20.17 N) and gumminess (0.16 N) of control processed cheese. Addition of 15% peanut also showed significantly ($p<0.05$) lower springiness and chewiness than the control cheese. It was found that peanut addition had no significant ($p>0.05$) effect on cohesiveness and adhesiveness of processed cheese. The decrease in the textural parameters can be attributed to the increase in moisture and fat content with the addition of peanuts. Alteration of ingredients affects the texture of the cheese by reducing the casein-casein and casein-fat interaction in cheese which seems to be responsible for determining its structure. Our results are in agreement with Marshall [25] and Pereira et al. [26] who reported that textural properties of processed cheese analogues decreased as the moisture content increased. Similarly, textural properties of peanut added processed cheese decreased with the increase in moisture content. This might be due to the action of water as plasticizer in the protein matrix making it less elastic and more susceptible to fracture upon compression [27]. Decrease in the textural properties might also be due to the increase in fat content with the addition of peanuts. When the fat content increased, all the above-mentioned textural properties of processed cheese samples reduced. Fat and moisture act as the filler in the casein matrix of cheese texture [28], giving it lubricity and softness. Olson and Johnson [29] also indicated that relative amounts of water, protein, and fat were the dominant factors effecting cheese hardness.

Meltability

Meltability of processed cheese decreased with increased level of peanuts but upto 10% addition no significant difference ($p>0.05$) was found as compared to the control (Table 2). Meltability (2.26) of 15% peanut added cheese was significantly lower than the control (4.19) even though the fat content was significantly more ($p<0.05$) than the control processed cheese (Table 1). The decrease in the meltability can be attributed to the addition of insoluble protein from peanuts which might have replaced the soluble caseins and interfere with the meltability of cheese. Meltability is no doubt one of the most important functional characteristics of cheese, in particular when cheese is used as a topping or is an ingredient in processed foods [30].

Sensory properties

There was no significant difference ($p>0.05$) in appearance among the control and peanut added cheeses (Table 3). Body and texture score did not reduce significantly ($p>0.05$) with the increase of peanut addition up to 10% however, 15% addition of peanuts significantly ($p<0.05$) reduced the score than that of the control cheese. The decrease in the body and texture scores could be attributed to the increase in the moisture content with the incorporation of peanuts. This was further confirmed from the textural studies (Figure 1) which showed that the textural properties decreased with the increase of peanut addition into the processed cheese. Flavour scores also reduced significantly

Samples	Meltability index
Control	4.19 ± 0.75[a]
5% Peanut	3.74 ± 0.61[a]
10% Peanut	3.06 ± 0.71[ab]
15% Peanut	2.26 ± 0.38[b]
Results are expressed as Mean ± S.D; means with different superscripts in a column differ significantly (p<0.05) (n=3).	

Table 2: Effect of peanut addition on meltability of processed cheese.

Parameters	Control PC	Peanut added PC		
		5%	10%	15%
Appearance (4)	3.60 ± 0.05[a]	3.57 ± 0.59[a]	3.57 ± 0.21[a]	3.60 ± 0.20[a]
Body and texture (8)	7.10 ± 0.17[a]	6.77 ± 0.258[ab]	6.73 ± 0.17[ab]	6.70 ± 0.19[b]
Flavour (8)	7.13 ± 0.10[a]	6.52 ± 0.277[ab]	6.60 ± 0.52[ab]	6.29 ± 0.49[b]
Overall acceptability (20)	17.84 ± 0.29[a]	16.86 ± 0.56[ab]	16.90 ± 0.7[ab]	16.59 ± 0.56[b]
Results are expressed as Mean ± S.D; means with different superscripts in a row differ significantly (p<0.05) (n=3).				

Table 3: Effect of peanut addition on the sensory properties of processed cheese.

(p>0.05) at 15% peanut addition. Peanut flavor was perceived in all the peanut containing cheese samples and the intensity increased with increased peanut addition. Cheese samples with 15% peanut resulted in a very strong peanut flavor which reduced its acceptability. The overall acceptability score of the peanut added cheese was lowest for 15% peanut added cheese (16.58) among the four samples which was significantly (p<0.05) lower than the control (17.84). The decreased acceptability was mainly because of the flavour characteristics while color and appearance didn't show any adverse impact on it.

Conclusion

In the current study, it was found that peanut addition up to 10% resulted in 7% to 8% reduction in the saturated fatty acid and conversely increased the unsaturated fatty acid content of the processed cheese. More reduction was found at higher levels of addition but the rheological and sensory properties showed significant adverse influence for 15% peanut added cheese. Therefore, 10% roasted peanut addition is suggested as optimum level to obtain a healthier fatty acid profile without any adverse effect on rheological and sensory properties of the processed cheese.

Acknowledgement

The first author expresses her sincere thanks to Dr. S. B. N Rao, Principal Scientist and Dr. Anjumoni Mech, Scientist, ICAR-National Institute of Animal Nutrition and Physiology, Bengaluru for their help to analyze fatty acids using Gas Chromatography.

References

1. Cerutti WG, Viegas J, Barbosa AM, Oliveira RL, Dias CA, et al. (2016) Fatty acid profiles of milk and minas frescal cheese from lactating grazed cows supplemented with peanut cake. J Dairy Res 83: 42-49.
2. Abou-zeid NA (2016) Nutraceutical ingredient poly-unsaturated fatty acids (PUFAs) fortification in milk and dairy products: A Review. Int J Adv Res Sci Eng Technol 3: 1420-1427.
3. Sanders TH (2001) Non-detectable levels of trans-fatty acids in peanut butter. J Agric Food Chem 49: 2349-2351.
4. Suchoszek-Lukaniuk K, Jaromin A, Korycińska M, Kozubek A (2011) Fatty acid content of commonly available nuts and seeds. Nuts and seeds in health and disease prevention, Elsevier, Netherlands. pp. 873-880.
5. Feldman EB (1999) Assorted monounsaturated fatty acids promote healthy hearts. America J Clini Nutr 70: 953-954.
6. Alper CM, Mattes RD (2002) Effects of chronic peanut consumption on energy balance and hedonics. J Int Assoc Stud Obes 26: 1129-1137.
7. Lopes RM, Agostini-Costa TDS, Gimenes MA, Silveira D (2011) Chemical composition and biological activities of Arachis species. J Agric Food Chem 59: 4321-4343.
8. Higgs J (2003) The beneficial role of peanuts in the diet-Part 2. Nutr Food Sci 33: 56-64.
9. Awad AB, Chan KC, Downie AC, Fink CS (2000) Peanuts as a source of β-sitosterol, a sterol with anticancer properties. Nutr Cancer 36: 238-241.
10. Isanga J, Zhang G (2009) Production and evaluation of some physicochemical parameters of peanut milk yogurt. Food Sci Technol 42: 1132-1138.
11. Razig KAA, Yousif AM (2010) Utilization of groundnut milk in manufacturing spread cheese. Pakistan J Nutr 9: 314-319.
12. Mazhuvanchery JJ (1981) IS: (SP:18) ISI handbook of food analysis. Part XI: Dairy products, Indian Standards Institution, New Delhi, India.
13. AOAC Association of Official Analytical Chemists (2005) Official methods of analysis. Washington, USA.
14. Awad S, Hassan AN, Halaweish F (2005) Application of exopolysaccharide-producing cultures in reduced-fat cheddar cheese: Composition and proteolysis. J Dairy Sci 8: 4195- 4203.
15. O'Fallon JV, Busboom JR, Nelson ML, Gaskins CT (2007) A direct method for fatty acid methyl ester synthesis: Application to wet meat tissues, oils and feedstuffs. J Anim Sci 85: 1511-1521.
16. Gunasekaran S, Mehmet Ak M (2003) Cheese texture. Cheese rheology and texture. CRC Press LLC, Boca Raton FL, USA.
17. Mleko S, Foegeding EA (2001) Incorporation of polymerized whey proteins into processed cheese analogs. Milchwissenschaft Milk Sci Int 56: 612-615.
18. Meyer (1973) Processed cheese manufacture. Food Trade Press Ltd, London, UK.
19. Siri-Tarino PW, Sun Q, Hu FB, Krauss RM (2010) Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. Am J Clin Nutr 91: 535-546.
20. Maguire LS, O'Sullivan Galvin K, O' Connor TP, O'Brien NM (2004) Fatty acid profile, tocopherol, squalene and phytosterol content of walnuts, almonds, peanuts, hazelnuts and the macadamia nut. Int J Food Sci Nutr 55: 171-178.
21. Andersen PC, Hill K, Gobert DW, Brodbeck BV (1998) Fatty acid and amino acid profiles of selected peanut cultivars and breeding lines. J Food Comp Anal 11: 100-111.
22. Kim NS, Lee JH, Han KM, Kim JW, Cho S, et al. (2014) Discrimination of commercial cheeses from fatty acid profiles and phytosterol contents obtained by GC and PCA. Food Chem 143: 40-47.
23. Parodi PW (2016) Dietary guidelines for saturated fatty acids are not supported by the evidence. Int Dairy J 52: 115-123.
24. Daniel DR, Thompson LD, Shriver BJ, Chich-Kang W, Hoover LC (2005) Non-hydrogenated cottonseed oil can be used as a deep fat frying medium to reduce trans-fatty acid content in french fries. J Am Diet Assoc 105: 1927-1932.
25. Marshall RJ (1990) Composition, structure, rheological properties and sensory texture of processed cheese analogues. J Sci Food Agric 50: 237-252.
26. Pereira RB, Bennett RJ, Hemar Y, Campanella OH (2001) Rheological and microstructural characteristics of model processed cheese analogues. J Textur Studie 32: 349-373.
27. Fox PF, Guinee TP, Cogan TM, Mcsweene PLH (2000) Fundamentals of cheese Science. Aspen Publication, Gaithersburg, MO, USA.
28. Madadlou A, Khosroshahi A, Mousavi ME (2005) Rheology, microstructure and functionality of low-fat Iranian White cheese made with different concentrations of rennet. J Dairy Sci 88: 3052-3062.
29. Olson NF, Johnson ME (1990) Light cheese products: Characteristics and economics. Food Technol 44: 93-97.
30. Wang HH, Sun DW (2002) Correlation between cheese meltability determined with a computer vision method and with Arnott and Schreiber tests. J Food Sci 67: 745-749.