talenta PUBLISHER

SUMEJ
Sumatera Medical Journal
Journal homepage: https://talenta.usu.ac.id/smj

Research Article

Development and Characterization of Fermented Fat Spread from Cow Milk and Coconut Milk Creams

Jayasooriya DGSC, Dias PGI*

Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, 70140, Sri Lanka

*Corresponding Author: gayanidias@appsc.sab.ac.lk

ARTICLE INFO

Article history:
Received 12 July 2025
Revised 27 February 2026
Accepted 1 April 2026
Available online 1 May 2026

E-ISSN: 2622-1357
P-ISSN: 2622-9234

How to cite:
Jayasooriya DGSC, Dias PGI, "Development and Characterization of Fermented Fat Spread from Cow Milk and Coconut Milk Creams", SUMEJ, Vol. 09, No. 02, May 2026.

https://doi.org/10.32734/sumej.v9i2.21934.

ABSTRACT

Background: Dairy alternatives that reduce unhealthy animal fat are an emerging food trend. Although plant-based fermented fat spreads are available globally, they remain limited in Sri Lanka. **Objective:** This study aimed to develop a fermented fat spread using cow and coconut milk creams. **Methods:** Five formulations were prepared: NFCC, NFCOC, FCC, FCOC, and a 1:1 fermented blend (FMC). Fermentation used mixed cultures of *Lactobacillus spp.*, *Streptococcus spp.*, and *Bifidobacterium lactis*. Analyses included yield, churning efficiency, composition, melting point, texture, sensory properties, and shelf stability. **Results**: FCOC showed significantly higher ($p<0.05$) churning efficiency, fat content, and unsaturated fatty acids, with a lower melting point (27.33 ± 0.50 °C). Blending fermented creams improved the melting point (30.67 ± 0.57 °C) and texture stability at room temperature. Coconut cream enhanced cohesiveness and spreadability. NFCC had the highest overall sensory acceptability, while FMC scored highest for appearance. FCOC exhibited superior shelf stability with lower peroxide values and microbial counts. **Conclusion:** The blended fermented spread offers a promising method for improving healthy fat while enhancing the texture stability and cost-effectiveness of the process. This method may avoid chemical hydrogenation-induced trans-fat formation in plant-based fat spreads.

Keywords: coconut milk cream, consumer acceptability, cow milk cream, fermented cream, healthy fat

1. Introduction

Sri Lanka, as the world's fifth-largest producer of coconuts, possesses significant but underutilized potential for the development of value-added coconut-based products, including innovative spreads [1]. While traditional dairy butter, primarily derived from cow's milk cream, is a staple in many diets due to its rich nutrient profile, fermented butter products remain relatively uncommon in Sri Lanka. This is largely because the characteristic tangy flavor of fermented butter does not align well with local taste preferences [2].

Fermentation of dairy butter enhances the bioavailability of nutrients and introduces probiotics, offering notable health benefits such as improved digestion and gut health [3]. Simultaneously, there is a rising global and local demand for plant-based milk products, driven by their healthy fat composition and suitability for lactose-intolerant consumers [4,5]. Coconut milk cream, a widely available plant-based cream in Sri Lanka, presents an attractive alternative due to its creamy texture and subtle sweetness, which could complement and modify the flavor of fermented butter to better suit local palates [3].

However, plant-based creams like coconut milk are prone to melting at room temperature, limiting their stability and usability in spreads. Chemical hydrogenation is commonly used to improve this stability, but it can generate harmful trans fats, posing health risks [6]. Therefore, there is a critical need to develop stable, nutritious, and consumer-friendly fat spreads without resorting to such processes.

This research aims to develop a novel fermented spread by combining cow milk cream and coconut milk cream, leveraging the strengths of both ingredients. The dairy component offers desirable texture and nutritional qualities, while the coconut milk cream can enhance the flavor profile, add healthy fats, and improve the spread's appeal to a wider audience, including lactose-intolerant individuals. By blending these two creams, the study seeks to improve product stability, nutritional value, probiotic benefits, and sensory acceptance, thus promoting healthier and more sustainable food choices within the Sri Lankan market.

2. Methods

2.1. Raw Material Collection and Preparation

Fresh cow's milk was sourced from a small farm in Pabahinna, and mature coconuts were obtained from the local market. Coconut milk was extracted by mixing scraped coconut with hot water and filtering the mixture.

2.2. Preparation of Butter Samples

2.2.1. Non-Fermented Butter

Cow's milk and coconut milk were separately pre-heated to 36–40 °C and subjected to cream separation using a cream separator. The separated creams were pasteurized at 63 °C for 30 minutes and cooled. Each cream was then churned individually to produce 100% cow's cream butter and 100% coconut cream butter (Table 1). The butter was kneaded to remove residual buttermilk and stored under refrigerated conditions.

2.2.2. Fermented Butter

Pasteurized and cooled cow's and coconut creams were inoculated with 0.5% ABY-3 starter culture, which contains *Lactobacillus* spp, *Streptococcus* spp, and *Bifidobacterium lactis*. The inoculated creams were incubated at 37–42 °C for 4–6 hours until the pH reached 4.8 ± 0.2. Fermented creams were then churned and kneaded to prepare butter samples with varying cow's cream to coconut cream ratios (100:0, 50:50, 0:100) (Table 1). All samples were stored under refrigerated conditions.

Table 1. Cow and coconut cream percentage of fat spreads

Sample name	Non-fermented cow's cream (%)	Fermented cow cream (%)	Non-fermented coconut cream (%)	Fermented coconut cream (%)
NFCC	100	-	-	-
NFCOC	-	-	100	-
FCC	-	100	-	
FCOC	-	-	-	100
FMC	-	50	-	50

2.3. Yield Determination

Cream yield was calculated by separating cream from a known volume of cow's milk and coconut milk. Butter yield was determined by comparing the weight of the final butter to the initial cream weight. The following formulas were used:

Cream Yield (%) = (Weight of Cream / Weight of Milk) × 100
Butter Yield (%) = (Weight of Butter / Weight of Cream) × 100

2.4. Sensory Evaluation

A paired comparison test was conducted to assess consumer preference between non-fermented and fermented cow's cream butter. A total of 30 semi-trained panelists participated in the evaluation. A 5-point hedonic scale (1 = dislike extremely to 5 = like extremely) was used to evaluate sensory attributes of butter samples. A group of 30 semi-trained panelists assessed appearance, color, aroma, taste, mouthfeel, aftertaste, and overall acceptability.

2.5. Proximate Analysis

The chemical composition of butter samples was analyzed using standard AOAC methods. Moisture content was determined according to AOAC Method 934.01, and total solids were calculated by subtracting the moisture percentage from 100%. Ash content was measured using AOAC Method 900.02, where samples were incinerated in a muffle furnace at 550 °C for 4 hours. Fat content was determined according to AOAC Method 989.05. Solid non-fat content was obtained by subtracting the fat content from the total solid content [7].

2.6. Instrumental and Physicochemical Analysis

The melting point of each butter sample was determined by placing 10 g of the sample in a boiling tube immersed in a water bath and recording the temperature at the onset of melting using a thermometer. Color measurements were conducted using a Konica Minolta Chroma Meter CR-400, with results expressed in terms of CIE L* (lightness), a* (red-green), and b* (yellow-blue) values. Texture Profile Analysis (TPA) was performed using a Brookfield Texture Analyzer equipped with a TA5 cylindrical probe to evaluate key textural attributes, including hardness, cohesiveness, and adhesiveness. Fourier Transform Infrared (FTIR) spectroscopy was carried out in attenuated total reflectance (ATR) mode over the range of 4000–400 cm^{-1} to identify functional groups and molecular structures present in the butter samples.

2.7. Shelf Life Evaluation

Shelf life was assessed by measuring peroxide values weekly for three weeks using iodometric titration to monitor oxidative rancidity. Microbial stability was evaluated by determining yeast and mold counts on potato dextrose agar (PDA). Additionally, the pH of melted butter samples was measured at 25 °C using a digital pH meter to track acidity changes during storage.

3. Results

3.1. Cream yield, butter yield, and churning efficiency

As shown in Figure 1, coconut milk yields significantly more cream than cow's milk, primarily due to its higher fat content (≥ 20% vs. 3.5–4%) and the predominance of medium-chain saturated fatty acids (45–55%) [8], which contribute to more efficient fat separation during processing.

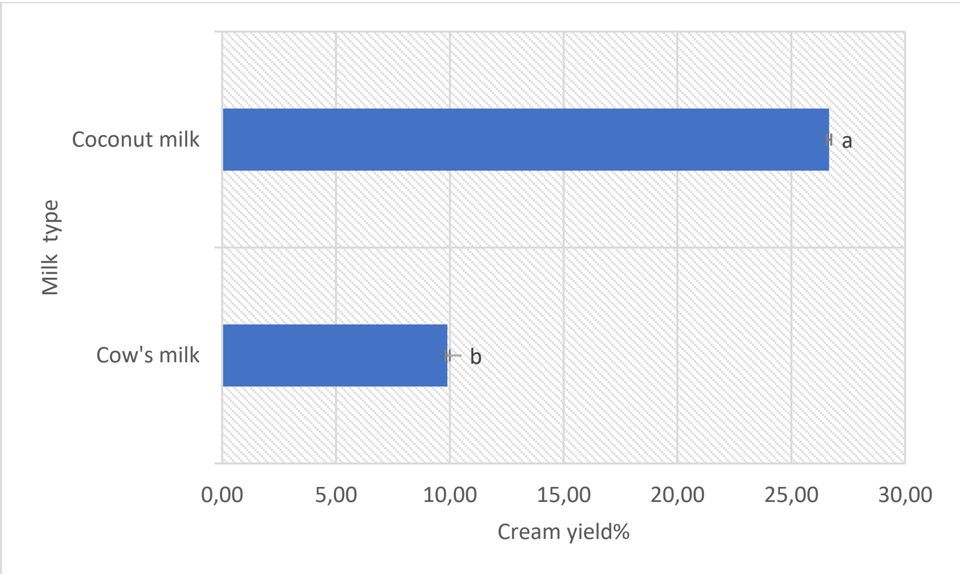

Figure 1. Percent cream yield of cow's milk and coconut milk

Table 2 indicates that butter yield from coconut cream also surpasses that of cow's milk cream, with fermentation further enhancing this output. Additionally, both fermented and non-fermented coconut cream require significantly less churning time than cow's cream, with fermentation further reducing the time. This shorter churning time boosts processing efficiency and reduces production costs. Fermentation may break down proteins and polysaccharides in the cream, improving fat separation during churning. Microbial or enzymatic activity can reduce emulsion stability, making fat globules coalesce more easily, helpful in butter making [3].

Table 2. Butter yield and churning time of fat spreads

Butter/margarine/spread type	Butter yield%	Churning time (hours)
Non-fermented cow's cream	5.50±0.01[e]	4.03±0.05[a]
Non-fermented coconut cream	49.67±0.30[b]	3.20±0.10[b]
Fermented cow's cream	6.51±0.01[d]	4.07±0.12[a]
Fermented coconut cream	53.15±0.14[a]	1.10±0.10[d]
Fermented cow’s and coconut cream (1:1)	46.00±0.12[c]	2.12±0.02[c]

3.2. Sensory evaluation

The paired comparison preference test showed that fermented cow’s cream butter was less preferred by consumers, with only 23.33% favoring it, compared to 76.67% who preferred the non-fermented version. The lower preference for fermented butter may be due to the tangy or sour flavor developed during fermentation, which might not align with the typical taste preferences of Sri Lankan cuisine [2]. Consumer preference tests using the hedonic scale revealed that fermented cow’s cream butter received the least preference for taste, mouthfeel, aftertaste, and overall acceptability. Fermented coconut cream margarine obtained the least preference for appearance and color. However, the preference for these parameters is significantly enhanced when cow’s cream is mixed with coconut cream. There was no significant difference in the overall acceptability of non-fermented cow’s cream butter (control) and fermented cow’s and coconut cream (1:1) blend fat spread (Figure 2).

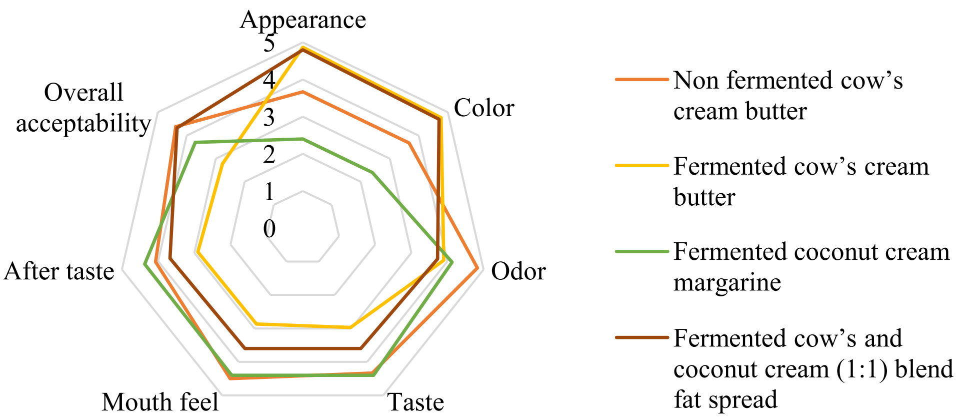

Figure 2. Radar diagram of consumer preference for fat spreads

3.3. Proximate composition

According to the Codex Standard for Butter, butter must contain a minimum milk fat content of 80% (m/m), a maximum moisture content of 16% (m/m), and a maximum milk solids-not-fat (MSNF) content of 2% (m/m) [8]. Some cow’s cream butter samples slightly deviated from these specifications, particularly in terms of fat and moisture percentages (Table 3). The fat content of coconut cream butter samples was ≥ 80%, meeting the threshold for classification as "margarine" under the Codex Standard for fat spreads and blended spreads [9]. In contrast, the fat content of the blended spread samples was below 80%, thereby classifying them as "blended fat spreads" under the same standard.

Table 3. Proximate composition and product specifications of fat spreads

Butter/margarine/ spread sample	Fat %	Moisture %	Milk solid non-fat (MSNF) %	Total solid (TS) %	Ash %
Non-fermented cow's cream	77.50±0.50^{d}	21.00±1.71a	1.50±0.50^{a}	79.00±1.71^{b}	0.10±0.02^{c}
Non-fermented coconut cream	80.83±0.86^{b}	17.67±2.01c	1.50±0.76^{a}	82.33±2.01^{ab}	0.27±0.04^{ab}
Fermented cow's cream	78.60±0.52^{cd}	19.53±2.21a	1.87±0.53^{a}	80.47±2.21^{ab}	0.15±0.06^{bc}
Fermented coconut cream	82.57±0.60^{a}	15.33±2.00c	2.10±0.60^{a}	84.67±2.00^{a}	0.40±0.09^{a}
Fermented cow's and coconut cream (1:1)	79.17±0.29^{c}	16.33±1.33b	2.50±0.29^{a}	81.67±1.33^{a}	0.26±0.05^{ab}

3.4 Physicochemical properties

3.4.1 Instrumental color values

A higher b* value means a stronger yellow hue. Cow's cream naturally contains more yellow pigments like carotenoids [10]. Coconut cream lacks these pigments, giving a paler or whiter appearance. Fermentation does not have a significant impact on color values (Table 4). This observation is consistent with previous findings where microbial fermentation was found to influence flavor and texture of dairy products rather than pigmentation, unless pigments are produced by specific microbial strains, which is uncommon in dairy fermentation [11].

Table 4. Instrumental color values of fat spreads

Butter/margarine/ spread sample	L*	a*	b*
Non-fermented cow's cream	38.17±3.82^{ab}	-1.56±0.14^{c}	21.42±1.33^{a}
Non-fermented coconut cream	28.13±1.12^{c}	-0.44±0.13^{a}	3.01±0.07^{c}
Fermented cow's cream	39.74±2.94^{a}	-1.92±0.08^{d}	21.03±2.46^{a}
Fermented coconut cream	28.71±0.41^{c}	-0.25±0.02^{a}	3.31±0.12^{c}
Fermented cow's and coconut cream (1:1)	33.62±0.82^{bc}	-1.26±0.11^{b}	11.91±11.80^{b}

3.4.2 Melting point and texture properties

The physical characteristics of fat-based spreads are significantly influenced by the type of cream used and the effects of fermentation. The present study revealed that coconut cream margarine exhibits a significantly lower melting point compared to cow's cream butter. This difference is attributed to the high content of medium-chain triglycerides (MCTs), particularly lauric, capric, and caprylic acids, in coconut cream, which possess lower melting points than the long-chain fatty acids predominant in cow's milk fat [12].

Fermentation further reduced the melting point of both coconut and cow's cream products. This could be due to microbial lipase activity, which modifies the lipid structure and increases the proportion of unsaturated fatty acids, thereby lowering thermal stability [13]. However, blending fermented creams from both sources improved the melting behavior, likely due to the combined fat matrix yielding a more balanced solid fat content (SFC) profile, improving both spreadability and structural integrity.

Interestingly, coconut cream–based spreads were found to be harder than those from cow's cream at room temperature, likely due to their higher saturated fat content and rapid fat crystallization. However, fermentation improved the softness and cohesiveness of both types of spreads. This agrees with previous findings where fermentation enhanced textural properties by increasing the levels of health-beneficial unsaturated fatty acids such as conjugated linoleic acid (CLA) and by the production of exopolysaccharides, which contribute to better mouthfeel and spreadability [14]. These results suggest that fermentation and cream blending can optimize the texture and storage stability of alternative fat spreads, especially when using plant-based sources like coconut cream.

Table 5. Melting point and texture profile of fat spreads

Butter/margarine/ spread sample	Melting point (°C)	Hardness (g)	Cohesiveness	Adhesiveness (mJ)
Non-fermented cow's cream	40.67±0.58^{a}	542.03±2.40^{b}	0.74±0.01^{a}	0.54±0.02^{b}
Non-fermented coconut cream	32.67±0.58^{c}	690.50±1.70^{a}	0.59±0.01^{d}	0.44±0.02^{c}
Fermented cow's cream	34.67±0.50^{b}	377.90±2.61^{e}	0.66±0.01^{bc}	0.67±0.02^{a}
Fermented coconut cream	27.33±0.50^{e}	422.83±2.68^{d}	0.64±0.03^{c}	0.38±0.02^{d}
Fermented cow's and coconut cream (1:1)	30.67±0.57^{d}	488.07±2.55^{c}	0.68±0.01^{b}	0.50±0.01^{b}

3.5. FTIR spectroscopy analysis

FTIR spectroscopy was used to analyze the structural composition of fermented cow's cream butter, fermented coconut cream margarine, and the blended fat spread. All samples showed characteristic ester peaks around 1738–1740 cm^{-1} (C=O stretching) and 1173 cm^{-1} (C–O stretching), confirming the presence of triglycerides.

Cow cream butter showed typical dairy fat features, including peaks at 1463.95 and 1377.92 cm^{-1} (CH_2 and CH_3 bending) and 718.20 cm^{-1} (CH_2 rocking), indicating saturated long-chain fatty acids. Coconut cream margarine also exhibited strong ester signals but displayed a distinct band at 1640.84 cm^{-1}, likely due to unsaturation or water content, reflecting its higher proportion of medium-chain fatty acids.

The mixed fat sample showed additional peaks at 2916.67 and 2649.90 cm^{-1} (C–H stretching), consistent with the presence of both long- and medium-chain fatty acids. The spectrum retained major features from both individual fats, confirming successful blending.

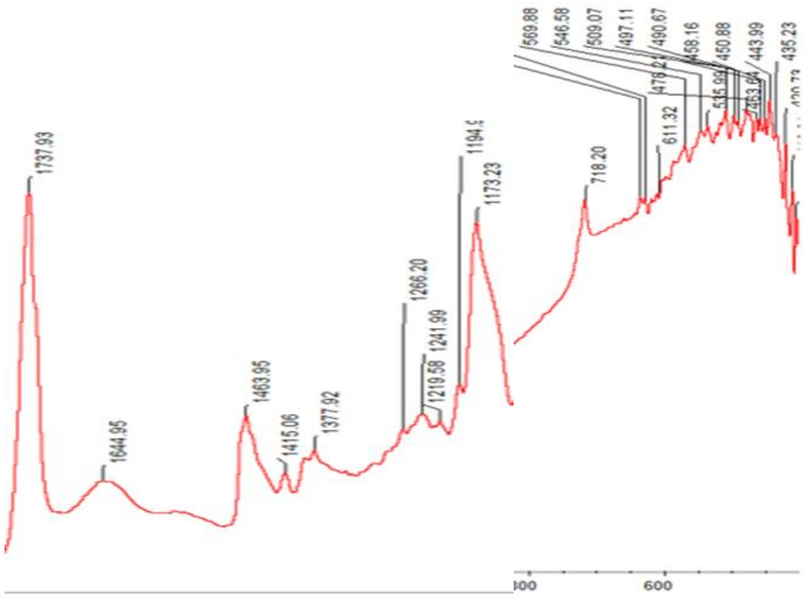

Figure 3. FTIR graphs for fermented cow's cream butter sample

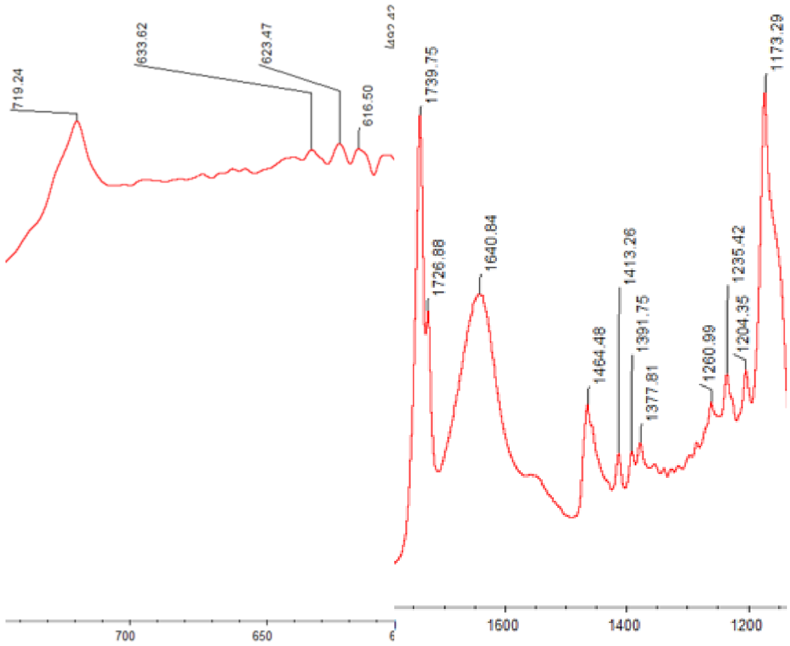

Figure 4. FTIR graphs for fermented coconut cream margarine sample

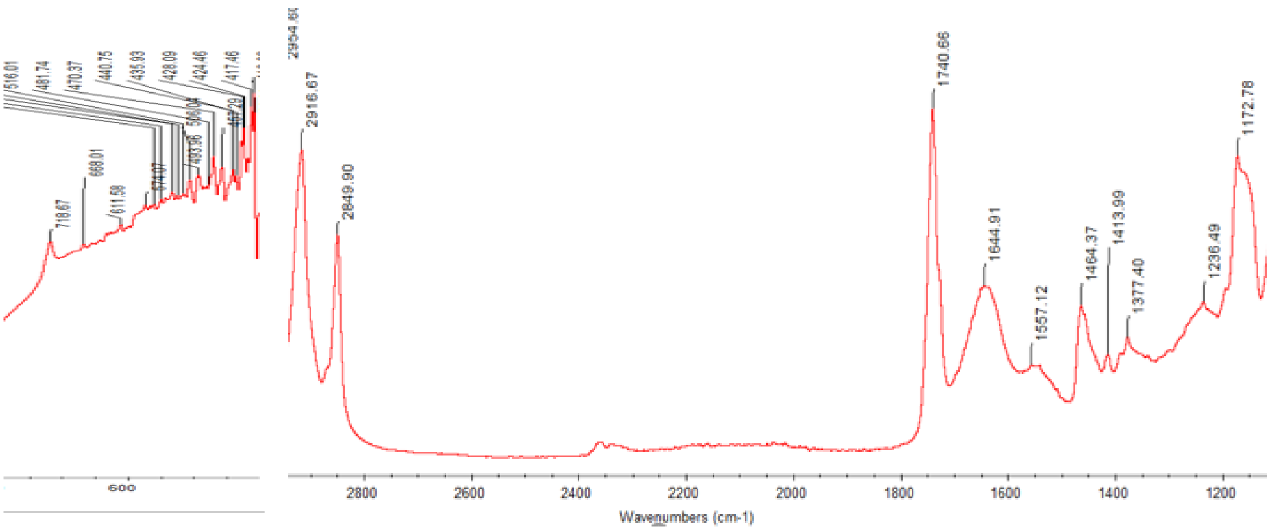

Figure 5. FTIR graphs for fermented cow's and coconut cream (1:1) blend fat sample

3.6. Shelf-life evaluation

3.6.1 pH value and microbial stability

The pH of the fermented butter samples remained relatively stable over 21 days of room temperature storage, indicating enhanced buffering capacity and microbial stability due to the presence of lactic acid bacteria. In contrast, a slight decline in pH was observed in non-fermented samples (Figure 6), likely due to microbial activity leading to acid production over time. Microbiological analysis revealed that yeast and mold counts in butter samples ranged between 50 and 5×10^4 CFU/g after 14 days of storage. While Codex Alimentarius [8] does not set a specific limit for yeast and mold in butter, it mandates that products must comply with good hygienic practices to ensure safety and quality.

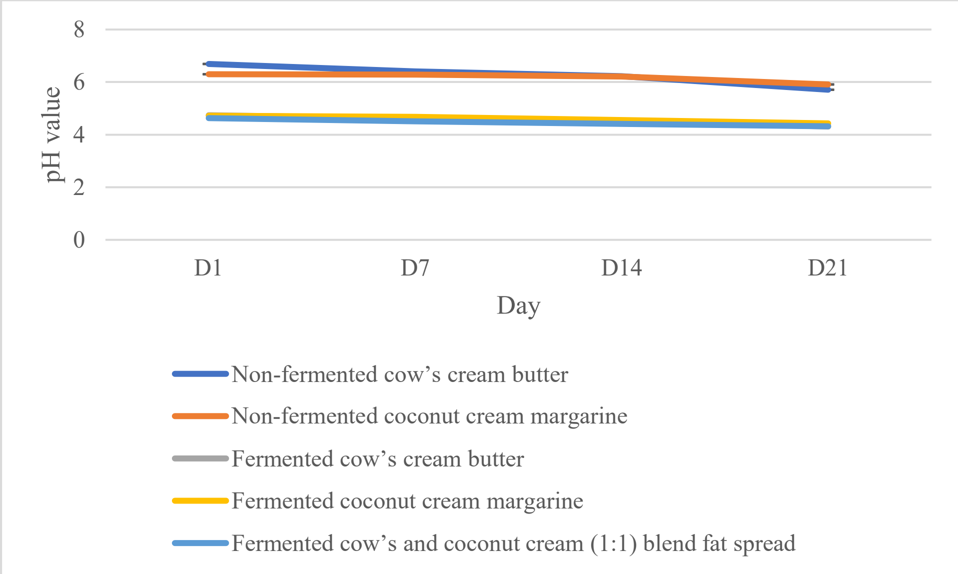

Figure 6. Alteration of the pH value of fat spreads over three weeks

The lower peroxide values observed in fermented fat spreads after 21 days of storage suggest improved oxidative stability compared to non-fermented counterparts. Fermentation may contribute to this stability by producing bioactive compounds such as organic acids and antioxidant peptides, which can inhibit lipid peroxidation [15]. In contrast, the highest peroxide value was detected in non-fermented cow's cream butter.

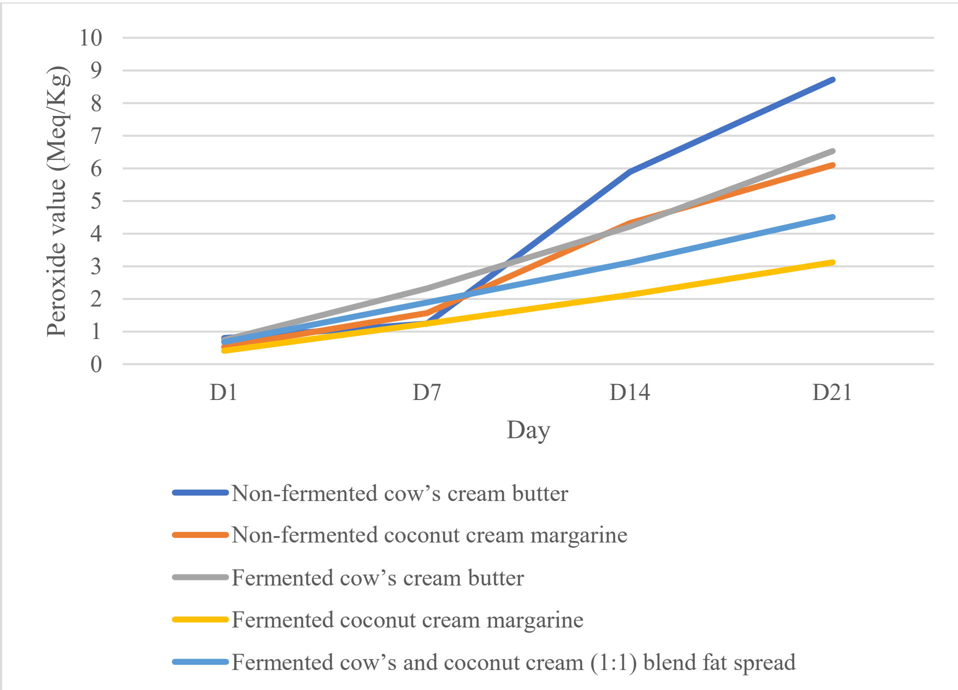

Figure 7. Alteration of the peroxide value of fat spreads over three weeks

4. Discussion

This study was conducted to address the need for a stable and healthier fat spread by combining cow's milk cream and coconut milk cream, as highlighted in the introduction. The results demonstrate that coconut cream provides higher yield and processing efficiency due to its elevated fat content, while fermentation further enhances fat separation and reduces churning time. These findings support the potential of coconut-based ingredients as viable alternatives in fat spread production.

However, in line with concerns regarding consumer acceptance of fermented products, the sensory evaluation revealed lower preference for fermented cow's cream due to its acidic flavor. The incorporation of coconut cream improved overall acceptability, indicating that blending can balance sensory attributes while maintaining functional benefits. In terms of physicochemical properties, the differences observed between cow's and coconut cream confirm their distinct lipid profiles, with coconut cream contributing medium-chain fatty acids and lower melting points. Although this may reduce thermal stability, the blended fermented formulation demonstrated improved texture and melting behavior, suggesting a synergistic effect between the two fat sources.

Furthermore, fermentation contributed positively to product quality by enhancing unsaturated fatty acid content and improving oxidative and microbial stability. This aligns with the study objective of developing a fat spread that avoids chemical hydrogenation while maintaining stability and nutritional value. Overall, the combination of cow's milk and coconut milk creams, particularly under fermentation, represents a promising approach to producing a more stable, acceptable, and health-oriented fat spread, consistent with the increasing demand for functional and plant-based food alternatives.

5. Conclusion

Both cow's milk and coconut milk contain saturated fatty acids; however, FTIR analysis revealed that cow's milk is rich in long-chain fatty acids, whereas coconut milk predominantly contains MCTs. Fermentation enhances the unsaturated fatty acid content. Blending fermented cow and coconut creams improves the overall fatty acid profile by combining long-chain saturated fats with MCTs, while also enhancing sensory properties, spreadability, texture, and oxidative and storage stability. Economically, this blending approach can reduce production costs by partially replacing higher-cost dairy fat with plant-based fat without compromising desirable sensory and functional characteristics. The fermented fat blend may be health beneficial due to the presence of probiotics and a modified fatty acid profile.

6. Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations, but are available from the corresponding author upon reasonable request. The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

7. Ethical Statement

Sumatera Medical Journal (SUMEJ) is a peer-reviewed electronic internationaljournal. This statement below clarifies ethical behavior of all parties involved in the act of publishing an article in Sumatera Medical Journal (SUMEJ), including the authors, the chief editor, the Editorial Board, the peer-reviewer and the publisher (TALENTA Publisher Universitas Sumatera Utara). This statement is based on COPE's Best Practice Guidelines for Journal Editors.

8. Author Contributions

GDSC Jayasooriya and PGI Dias were involved in designing this research. GDSC Jayasooriya collected the data. GDSC and PGI Dias analyzed the data. GDSC Jayasooriya and PGI Dias were involved in the data interpretation and prepared the draft of the manuscript. PGI Dias was responsible for writing and finalizing the manuscript. All authors read and approved the final version of the manuscript.

9. Funding

No funding in this research/study.

10. Acknowledgements

The authors would like to thank all parties who contributed to this study and supported the completion of this research.

11. Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

[1] Aiome GN, Fernando SP, Kuruppu V, Jayampathi C, Samarakoon SMA. Impact of home garden coconut cultivation on coconut kernel-based industries in Sri Lanka [Internet]. Colombo: Hector

Kobbekaduwa Agrarian Research and Training Institute; 2021 [cited 2025 Jul 11]. Available from: http://www.harti.gov.lk/images/download/reasearch_report/new1/Report_240_or_web.pdf.
[2] Narayana NMNK, Fernando S, Samaraweera GC. Awareness and attitude towards functional dairy products among consumers in the Western Province of Sri Lanka. Turk J Agric Food Sci Technol [Internet]. 2020 [cited 2025 Jul 11];8(6):1308–14. Available from: https://doi.org/10.24925/turjaf.v8i6.1308-1314.3326.
[3] Ewe JA, Loo SY. Effect of cream fermentation on microbiological, physicochemical, and rheological properties of Lactobacillus helveticus butter. Food Chem [Internet]. 2016 [cited 2025 Jul 11];201:29–36. Available from: https://doi.org/10.1016/j.foodchem.2016.01.049.
[4] Abd Rahim MH. Palm milk: A nutritious, sustainable, and versatile plant-based alternative to coconut milk. Food Rev Int [Internet]. 2025 [cited 2025 Jul 11];1–16. Available from: https://doi.org/10.1080/87559129.2025.2473018.
[5] Chen Y, Zhang Z, Chen Y, Li T, Zhang W. The role of fat content in coconut milk: Stability and digestive properties. Food Chem [Internet]. 2024 [cited 2025 Jul 11];446:138900. Available from: https://doi.org/10.1016/j.foodchem.2024.138900.
[6] Kummerow FA. The negative effects of hydrogenated trans fats and what to do about them. Atherosclerosis [Internet]. 2009 [cited 2025 Jul 11];205(2):458–65. Available from: https://doi.org/10.1016/j.atherosclerosis.2009.03.009.
[7] Cunniff P, editor. Official methods of analysis of AOAC International. Gaithersburg (MD): Association of Official Analytical Chemists; 1996.
[8] Codex Alimentarius Commission. Standard for butter (CODEX STAN A-1-1971, Rev. 1-1999, Amended 2003) [Internet]. Rome: FAO/WHO; 2003 [cited 2025 Jul 11]. Available from: https://www.fao.org/fao-who-codexalimentarius/codex-texts/list-standards/en/.
[9] Codex Alimentarius Commission. Standard for fat spreads and blended spreads (CODEX STAN 256-2007) [Internet]. Rome: FAO/WHO; 2007 [cited 2025 Jul 11]. Available from: https://www.fao.org/fao-who-codexalimentarius/codex-texts/list-standards/en/.
[10] Agabriel C, Cornu A, Journal C, Sibra C, Grolier P, Martin B. Tanker milk variability according to farm feeding practices: Vitamins A and E, carotenoids, color, and terpenoids. J Dairy Sci [Internet]. 2007 [cited 2025 Jul 11];90(10):4884–96. Available from: https://doi.org/10.3168/jds.2007-0171.
[11] Lucey JA. Cultured dairy products: An overview of their gelation and texture properties. Int J Dairy Technol [Internet]. 2004 [cited 2025 Jul 11];57(2–3):77–84. Available from: https://doi.org/10.1111/j.1471-0307.2004.00142.x.
[12] Marina AM, Man YC, Amin I. Virgin coconut oil: Emerging functional food oil. Trends Food Sci Technol [Internet]. 2009 [cited 2025 Jul 11];20(10):481–7. Available from: https://doi.org/10.1016/j.tifs.2009.06.003.
[13] Hasan F, Shah AA, Hameed A. Industrial applications of microbial lipases. Enzyme Microb Technol [Internet]. 2006 [cited 2025 Jul 11];39(2):235–51. Available from: https://doi.org/10.1016/j.enzmictec.2005.10.016.
[14] Kim YJ, Liu RH. Increase of conjugated linoleic acid content in milk by fermentation with lactic acid bacteria. J Food Sci [Internet]. 2002 [cited 2025 Jul 11];67(5):1731–7. Available from: https://doi.org/10.1111/j.1365-2621.2002.tb08714.x.
[15] Stobiecka M, Król J, Brodziak A. Antioxidant activity of milk and dairy products. Animals (Basel) [Internet]. 2022 [cited 2025 Jul 11];12(3):245. Available from: https://doi.org/10.3390/ani12030245.