CHAPTER IV

RESULT AND DISCUSSION

4.1 Characterization of Raw Materials

The raw materials used in this study, namely jackfruit seed flour and coconut milk, were characterized prior to product development to determine their proximate composition. The compositional characteristics of these materials provide an important basis for understanding their functional roles in the formulation and their potential influence on the physicochemical and textural properties of the developed vegan cream cheese. The characterization results are presented in Table 2.

Table 2. Proximate Results of Jackfruit Seed Flour and Coconut Milk

Proximate Result	Jackfruit seed flour	Coconut Milk
Moisture (%)	10.42 ± 0.10	68.50 ± 0.17
Protein (%)	13.79 ± 0.17	2.65 ± 0.04
Fat (%)	1.12 ± 0.02	24.47 ± 0.19
Ash (%)	3.68 ± 0.16	0.69 ± 0.09
Carbohydrate by difference (%)	70.99 ± 0.19	3.70 ± 0.39

Note: Values are expressed as mean ± standard deviation (n = 4).

As presented in Table 2, jackfruit seed flour and coconut milk exhibited distinct proximate compositions. Jackfruit seed flour contained high carbohydrate and ash contents, whereas coconut milk was characterized by high moisture and fat contents. In contrast, the protein content of jackfruit seed flour was higher than that of coconut milk. These compositional differences indicate that each ingredient contributes different nutritional and functional properties to the vegan cream cheese formulation. The proximate composition of the raw materials also provides a basis

for interpreting the physicochemical characteristics of the optimized product discussed in the following sections.

4.2 Texture Properties

Texture analysis was performed to determine the effect of different concentrations of jackfruit seed flour on the texture of vegan cream cheese made with coconut milk. The analyzed parameters were hardness, hardness work done, adhesive force, and adhesiveness.

4.2.1 Hardness

Table 3. Hardness, absolute difference (Δ), and *p*-value of coconut milk-based vegan cream cheese formulations compared with the commercial dairy cream cheese benchmark

JSF Concentration % w/v	Hardness (g)	Δ Hardness (g)	p-value
JSF 2%	42.05 ± 1.98	9.05 ± 1.98	0.003
JSF 3%	46.72 ± 1.86	4.38 ± 1.86	0.018
JSF 4%	53.48 ± 2.81	2.63 ± 2.49	0.189
JSF 5%	60.82 ± 4.10	9.73 ± 4.10	0.018
JSF 6%	68.80 ± 5.00	17.70 ± 5.00	0.006

Note: Δ values represent the absolute difference between each treatment and the commercial dairy cream cheese (Puck) used as the benchmark. *p*-values were obtained using a one-sample *t*-test with the hardness value of the commercial benchmark as the test value. A *p*-value > 0.05 indicates no significant difference from the benchmark.

As shown in Table 3, hardness increased with increasing JSF concentration. JSF 4% had the smallest absolute difference from the benchmark and was not significantly different from it ($p = 0.189$). JSF 2%, JSF 3%, JSF 5%, and JSF 6% differed significantly from the benchmark ($p < 0.05$). This indicates that the 4% formulation had a peak compression force closest to that of the commercial product, although hardness alone was not used to select the optimum formulation.

Hardness is the maximum force recorded during compression and is commonly interpreted as the firmness of a semi-solid food. It describes the force

needed to initiate substantial deformation, rather than the total energy involved in compressing the sample. In the present formulations, the progressive increase in hardness from JSF 2% to JSF 6% indicates that the samples increasingly resisted the probe at the point of maximum compression. As presented in Table 2, jackfruit seed flour contained a high carbohydrate content (70.99%), providing starch as the main structure-forming component, whereas coconut milk contained high moisture (68.50%) and fat (24.47%) contents that supplied the continuous aqueous phase and dispersed fat droplets within the matrix. Coconut milk provides the continuous aqueous phase required for starch gelatinization, while its dispersed fat droplets become incorporated into the developing gel structure (Lu *et al.*, 2019). As described by Palav and Seetharaman (2006), during heating, starch granules absorb water from the coconut milk, swell, and undergo gelatinization, allowing amylose molecules to leach from the granules.

During subsequent refrigerated storage, partial reassociation of starch molecules further strengthened the gel structure through retrogradation, thereby increasing resistance to compression (Gong *et al.*, 2024). Furthermore, increasing the concentration of jackfruit seed flour increased the amount of starch available for gel formation. A higher starch concentration promoted the development of a denser and more continuous gel network capable of entrapping water and dispersed coconut oil droplets more effectively. Consequently, the internal matrix became progressively stronger and more resistant to deformation as the proportion of jackfruit seed flour increased. Similar observations have been reported by Diamantino et al. (2019), who found that starch-based dairy alternatives

compensate for the absence of casein by forming a continuous gel network that provides structural integrity. However, excessive hardness would reduce spreadability and negatively influence consumer perception (Ghorbel *et al.*, 2016).

4.2.2 Hardness Work Done

Table 4. Hardness work done, absolute difference (Δ), and *p*-value of coconut milk-based vegan cream cheese formulations compared with the commercial dairy cream cheese benchmark

JSF Concentration % w/v	Hardness Work Done (mJ)	Δ Hardness Work Done (mJ)	p-value
JSF 2%	2.09 ± 0.42	0.71 ± 0.42	0.042
JSF 3%	3.46 ± 0.58	0.67 ± 0.58	0.104
JSF 4%	4.29 ± 0.50	1.49 ± 0.50	0.010
JSF 5%	5.28 ± 0.56	2.48 ± 0.56	0.003
JSF 6%	5.74 ± 0.47	2.94 ± 0.47	0.001

Note: Δ values represent the absolute difference between each treatment and the commercial dairy cream cheese (Puck) used as the benchmark. *p*-values were obtained using a one-sample *t*-test with the hardness work done value of the commercial benchmark as the test value. A *p*-value > 0.05 indicates no significant difference from the benchmark.

As shown in Table 4, JSF 3% exhibited the smallest absolute difference in hardness work done (0.67 mJ) and was not significantly different from the benchmark ($p = 0.103$). JSF 2% also had a small difference (0.71 mJ), but its mean differed significantly from the benchmark ($p = 0.043$). JSF 4%, JSF 5%, and JSF 6% had larger differences and were significantly different from the benchmark ($p < 0.05$). Thus, JSF 3% most closely matched the benchmark in the total work required for compression.

Hardness work done represents the total energy required to compress the sample during the compression cycle and reflects the overall resistance of the product to deformation. Whereas hardness is determined by a single maximum-force value, work done reflects the area under the positive portion of the force–distance curve and therefore incorporates both force and deformation distance. Two

samples may consequently show similar hardness but require different amounts of energy to compress if their force response throughout the compression cycle differs (Yousefi-Mashouf *et al.*, 2023). Therefore, it provides a more comprehensive assessment of the mechanical strength of the gel matrix throughout the compression process.

The increasing hardness work done at higher JSF concentrations suggests that the probe encountered greater cumulative resistance during compression. This response may arise from a more concentrated starch gel that resists deformation over a larger part of the compression path, rather than from a change in peak force alon. During heating, starch granules absorbed water, swelled, and gelatinized, while subsequent refrigerated storage promoted partial starch retrogradation, further strengthening the gel network (Gong *et al.*, 2024). Consequently, greater energy was required to deform the samples as the concentration of jackfruit seed flour increased (Wu *et al.*, 2024).

4.2.3 Adhesive Force

Table 5. Adhesive force, absolute difference (Δ), and p-value of coconut milk-based vegan cream cheese formulations compared with the commercial dairy cream cheese benchmark

JSF Concentration % w/v	Adhesive Force (g)	Δ Adhesive Force (g)	p-value
JSF 2%	12.47 ± 0.50	5.58 ± 0.50	<0.001
JSF 3%	18.45 ± 0.53	0.40 ± 0.50	0.226
JSF 4%	22.35 ± 1.93	4.30 ± 1.93	0.021
JSF 5%	24.05 ± 0.91	6.00 ± 0.91	0.001
JSF 6%	26.30 ± 1.87	8.25 ± 1.87	0.003

Note: Δ values represent the absolute difference between each treatment and the commercial dairy cream cheese (Puck) used as the benchmark. *p*-values were obtained using a one-sample *t*-test with the adhesive force value of the commercial benchmark as the test value. A *p*-value > 0.05 indicates no significant difference from the benchmark.

As shown in Table 5, JSF 3% had the smallest absolute difference in adhesive force (0.40 g) and was not significantly different from the benchmark ($p = 0.226$). The other formulations differed significantly from the benchmark ($p < 0.05$), with absolute differences ranging from 4.30 to 8.25 g. The result indicates that the probe-detachment force of JSF 3% was closest to that of the commercial product.

Adhesive force represents the maximum negative force required to detach the probe from the sample surface following compression. This parameter reflects the interaction between the sample surface and the probe and is influenced by surface hydration, water retention, and the continuity of the gel matrix (Pierce *et al.*, 1994). This hydrated gel structure increased the contact area and interaction between the sample surface and the probe, thereby requiring greater force to separate the probe from the sample (Donmez *et al.*, 2021). The low adhesive force of JSF 2% may be associated with a less developed matrix and a lower amount of material retained at the probe interface. As JSF concentration increased, the larger adhesive force values may reflect increased surface cohesion and contact between the hydrated sample and probe (Arlai and Tananuwong, 2021).

4.2.4 Adhesiveness

Table 6. Adhesiveness, absolute difference (Δ), and p-value of coconut milk-based vegan cream cheese formulations compared with the commercial dairy cream cheese benchmark

JSF Concentration % w/v	Adhesiveness (mJ)	Δ Adhesiveness (mJ)	p-value
JSF 2%	1.57 ± 0.22	0.18 ± 0.12	0.523
JSF 3%	1.76 ± 0.14	0.14 ± 0.09	0.218
JSF 4%	1.92 ± 0.10	0.27 ± 0.10	0.012
JSF 5%	2.06 ± 0.22	0.41 ± 0.22	0.034
JSF 6%	2.11 ± 0.21	0.46 ± 0.21	0.023

Note: Δ values represent the absolute difference between each treatment and the commercial dairy cream cheese (Puck) used as the benchmark. *p*-values were obtained using a one-sample *t*-test with

the adhesiveness value of the commercial benchmark as the test value. A *p*-value > 0.05 indicates no significant difference from the benchmark.

As shown in Table 6, JSF 3% had the smallest absolute difference in adhesiveness (0.11 mJ) and was not significantly different from the benchmark ($p = 0.202$). JSF 2% was also not significantly different ($p = 0.547$), although its absolute difference was smaller than that of the higher-concentration formulations. JSF 4%, JSF 5%, and JSF 6% differed significantly from the benchmark ($p < 0.05$). The increase in adhesiveness at higher JSF levels indicates that more work was required to separate the probe from the sample.

Adhesiveness represents the total negative work required to overcome the attractive forces between the sample and the probe during withdrawal and is commonly associated with product stickiness. Unlike adhesive force, which measures the maximum detachment force, adhesiveness reflects the total energy required to completely separate the probe from the sample (Goh *et al.*, 2026). According to Gong et al. (2024), as the amount of gelatinized starch increased, more water became immobilized within the gel structure. This produces a stickier matrix that required greater work to detach from the probe. As a result, greater energy was required to completely detach the probe from formulations containing higher concentrations of jackfruit seed flour.

Increasing the concentration of jackfruit seed flour supplied more starch for gel formation, producing a denser and more cohesive matrix with enhanced water-binding capacity (Mohammed *et al.*, 2024). Consequently, formulations containing higher levels of jackfruit seed flour exhibited greater adhesiveness because more work was required to overcome the attractive forces between the sample and the

probe. However, excessive adhesiveness may result in a stickier product that differs from the desirable characteristics of commercial cream cheese. Although both JSF 2% and JSF 3% were not significantly different from the commercial benchmark, JSF 3% exhibited the smallest Δ value, indicating the closest similarity in adhesiveness to the benchmark.

Overall, texture optimization demonstrated that different concentrations of jackfruit seed flour produced distinct texture characteristics in coconut milk-based vegan cream cheese. The formulation containing 4% jackfruit seed flour (JSF 4%) exhibited the hardness comparable to the commercial benchmark. In contrast, the formulation containing 3% jackfruit seed flour (JSF 3%) exhibited the closest similarity in hardness work done and adhesive force and, together with JSF 2%, was not significantly different from the benchmark in adhesiveness. Furthermore, JSF 3% exhibited the smallest Δ values for hardness work done, adhesive force, and adhesiveness, indicating the closest overall similarity to the commercial cream cheese. Considering all measured texture parameters collectively, JSF 3% (3% w/v jackfruit seed flour) was selected as the optimum formulation for subsequent proximate and sensory characterization.

4.3 Proximate

To characterize the optimized formulation, proximate analysis was performed to determine its moisture, protein, fat, ash, and carbohydrate contents. The results were compared with those of the commercial dairy cream cheese (Puck) to evaluate the compositional characteristics of the developed product.

Prior to comparative analysis, the data were evaluated to ensure that the assumptions for parametric analysis were satisfied. Since all parameters met these assumptions, comparisons between the optimized formulation and the commercial benchmark were performed using an independent samples *t*-test. The detailed results of the assumption tests are provided in Appendix 7. The proximate composition of the optimized vegan cream cheese and the commercial benchmark is presented in Table 7.

Table 7. Proximate composition of the optimized vegan cream cheese and commercial dairy cream cheese (Puck)

Analysis	Optimized	Benchmark
Moisture Content (%)	57.70 ± 0.31	48.36 ± 0.51
Protein Content (%)	3.26 ± 0.26	1.95 ± 0.08
Fat Content (%)	24.76 ± 0.02	18.41 ± 1.65
Ash Content (%)	1.15 ± 0.03	2.99 ± 0.09
Carbohydrate Content (%)	13.40 ± 0.31	28.29 ± 1.78

Note: Values are presented as mean ± standard deviation (n = 4).

a. Moisture Content

As shown in Table 7, the optimized vegan cream cheese exhibited a significantly higher moisture content (57.70 ± 0.31%) than the commercial dairy cream cheese benchmark (48.36 ± 0.51%) ($p < 0.001$). The higher moisture content of the optimized formulation is associated with the compositional characteristics of its raw materials. As presented in Table 2, coconut milk contained a high moisture content (68.50%), while jackfruit seed flour possessed considerable water absorption capacity due to its starch-rich composition. The combination of these ingredients promoted water retention within the product matrix, resulting in a significantly higher moisture content than that of the commercial benchmark.

The higher moisture content can be attributed to the interaction between jackfruit seed flour and the aqueous phase of coconut milk during heating and

subsequent cooling. Jackfruit seed flour has been reported to possess high water absorption and swelling capacity, making it suitable for use in hydrated food systems where moisture retention and gel formation are important for texture development (Reddy, 2022).

During thermal treatment, starch granules in jackfruit seed flour absorb water, swell, and undergo gelatinization, while amylose molecules leach from the granules and form a continuous gel network capable of immobilizing water within the product matrix (Qian *et al.*, 2025). In parallel, protein fractions in jackfruit seed flour denature and expose additional hydrophilic groups, further enhancing water binding and reinforcing the hydrated network (Ulloa *et al.*, 2017). These combined phenomena increase the amount of water retained in the optimized formulation relative to the benchmark, explaining its higher moisture content.

The increased moisture content is likely associated with the softer and more spreadable texture observed in the optimized vegan cream cheese. In high-moisture, starch–protein gels, water acts as a plasticizer, reducing the effective solid content and decreasing the resistance to deformation (Zhang *et al.*, 2025). It typically translates into lower hardness and improved spreadability in cream cheese-type products. Studies on plant-based and analogue cheeses have reported that formulations with higher moisture and strong water-binding components tend to exhibit reduced firmness and greater spreadability (Silva *et al.*, 2024). This supports the interpretation that the texture optimization achieved in the present study is closely linked to enhanced water retention.

Overall, the results suggest that jackfruit seed flour functions as a techno-functional ingredient that simultaneously increases moisture content and modulates the internal gel structure of vegan cream cheese made with coconut milk. By providing starch and protein capable of gelatinizing and binding water, jackfruit seed flour promotes the formation of a hydrated matrix that aligns with the textural attributes targeted in the optimization process. Formulations with moisture levels that balance softness and structural integrity are expected to be more acceptable to consumers (Silva *et al.*, 2024). This indicates that controlled incorporation of jackfruit seed flour can be an effective strategy for designing vegan cream cheese with desirable spreadability and mouthfeel.

b. Protein Content

As shown in Table 7, the optimized vegan cream cheese contained 3.26 ± 0.26% protein, compared with 1.95 ± 0.08% in the commercial benchmark. The protein in the vegan formulation was supplied mainly by jackfruit seed flour, with a smaller contribution from coconut milk. In contrast, the protein in dairy cream cheese is derived from milk, with casein forming the major protein fraction. The measured difference should be interpreted in relation to the particular ingredients and formulations used in this study, rather than as a general distinction between all vegan and dairy cream cheeses. From a nutritional perspective, the incorporation of jackfruit seed flour enhanced the protein contribution of the vegan cream cheese, improving its overall nutritional value (Luz *et al.*, 2024).

Beyond its nutritional role, protein also plays an important techno-functional role in the development of the internal structure of vegan cream cheese. During

thermal processing, proteins from jackfruit seed flour and coconut milk undergo denaturation, exposing reactive hydrophobic and hydrophilic groups that participate in protein–protein and protein–starch interactions within the matrix (Song *et al.*, 2026). These interactions complement the gelatinized starch network, resulting in a more cohesive and continuous gel structure capable of maintaining structural integrity during refrigerated storage (Zhang *et al.*, 2025). Consequently, the higher protein content of the optimized formulation contributes to the formation of a stronger and more stable plant-based gel network.

Unlike the optimized formulation, the commercial dairy cream cheese derives its structural integrity primarily from a casein-based gel network rather than interactions between plant proteins and starch (Surber *et al.*, 2021). Although the benchmark contained a lower measured protein content, its casein proteins possess functional properties that differ substantially from those of plant proteins. Casein forms a highly interconnected protein matrix that effectively entraps water and fat globules, contributing to the characteristic texture of dairy cream cheese (Sözeri Atik and Huppertz, 2025). Therefore, the higher protein content observed in the optimized formulation should not be interpreted as indicating a stronger structure than the commercial benchmark, but rather as reflecting the additional protein supplied by jackfruit seed flour to compensate for the absence of casein

c. Fat Content

As shown in Table 7, optimized vegan cream cheese had a fat content of 24.76 ± 0.02%, whereas the commercial dairy benchmark contained 18.41 ± 1.65%. This difference is primarily associated with the compositional characteristics of raw

materials. As presented in Table 2, coconut milk contained a high fat content (24.47%), making it the major lipid source in the optimized formulation. Consequently, the incorporation of coconut milk contributed substantially to the total fat content of the developed vegan cream cheese.

Fat contributes to creaminess, lubrication, flavor release, and the mechanical response of cream cheese. In dairy cream cheese, fat globules are embedded within a casein-rich matrix, and their size, partial coalescence, and interactions with the protein network influence texture (Zhou *et al.*, 2022). In the vegan formulation, coconut fat droplets are dispersed in a starch–plant protein matrix (Zhou *et al.*, 2022). Therefore, the higher fat content of the optimized formulation may contribute to a creamy mouthfeel, but it does not guarantee the same sensory or textural properties as dairy fat (Mu *et al.*, 2022).

d. Ash Content

As shown in Table 7, commercial dairy cream cheese had a higher ash content (2.99 ± 0.09%) than the optimized vegan cream cheese (1.15 ± 0.03%). Ash content represents the total mineral content of a food product and is influenced by the mineral composition of the ingredients used in the formulation (AOAC, 2006). The lower ash content of the optimized formulation primarily reflects the low proportion of jackfruit seed flour incorporated into the product. Although jackfruit seed flour is mineral-rich, it was added at only 3% (w/v), whereas coconut milk, which possesses a lower ash content, constituted the major component of the formulation.

As presented in Table 2, jackfruit seed flour contained 3.68% ash, consistent with the findings of Borgis (2020), who reported ash contents ranging from 1.15%

in unprocessed flour to 3.73% in baked flour. In contrast, the coconut milk used in this study contained only 0.69% ash, comparable to the value of approximately 0.63% reported by Darsana et al., (2026). Consequently, despite the high mineral content of jackfruit seed flour, its low incorporation level limited its overall contribution to the mineral composition of the optimized vegan cream cheese. The mineral profile of the final product was therefore largely influenced by coconut milk, resulting in a lower overall ash content. The higher moisture content of the optimized vegan cream cheese may also have contributed to the lower ash percentage when expressed on a wet basis. Because ash content is reported relative to the total sample weight, a greater proportion of water reduces the relative concentration of minerals in the product (Fikriyah and Nasution, 2021).

e. Carbohydrate Content

As shown in Table 7, the commercial dairy benchmark had a higher calculated carbohydrate content (28.29 ± 1.78%) than the optimized vegan cream cheese (13.40 ± 0.31%). In the present study, carbohydrate content was determined by difference according to the AOAC method, in which the percentages of moisture, protein, fat, and ash are subtracted from 100%. Consequently, the significantly higher moisture, protein, and fat contents of the optimized formulation mathematically resulted in a lower calculated carbohydrate content on a wet basis.

Although jackfruit seed flour contained a high carbohydrate content (70.99%), it was incorporated into the formulation at only 3% (w/v), whereas coconut milk constituted the major proportion of the formulation. Consequently, the contribution of jackfruit seed flour to the overall carbohydrate content of the

final product was limited. Therefore, the lower carbohydrate content of the optimized vegan cream cheese reflects both the by-difference calculation method and the low incorporation level of jackfruit seed flour. Similar observations have been reported in plant-based dairy analogues, where ingredients added at low concentrations contribute only modestly to the proximate carbohydrate content while exerting substantial functional effects on product quality (Grossmann and McClements, 2021; Gurbuz *et al.*, 2024).

The reduced carbohydrate percentage in the optimized formulation does not necessarily indicate a marked decrease in the starch available for gel formation and texture development. In systems where starch is the primary structuring carbohydrate, its functional contribution to gelation and network formation can remain significant even when the calculated carbohydrate fraction appears lower due to higher moisture and fat contents (Awasthi *et al.*, 2025). Jackfruit seed flour still provided starch capable of gelatinization and interaction with proteins and fat droplets, supporting the texture characteristics of the optimized vegan cream cheese despite the lower carbohydrate value on a proximate basis (Zehra and Ali, 2024).

4.4 Sensory Evaluation

Following the instrumental evaluation of texture and proximate composition, sensory evaluation was conducted to determine the panelists' perception and acceptance of the developed vegan cream cheese made with coconut milk. Sensory evaluation is essential because instrumental measurements alone cannot fully represent consumer perception of product quality (Torrico *et al.*, 2023). In this study, sensory evaluation consisted of an organoleptic scoring test to describe the

intensity of selected attributes and a hedonic test to evaluate panelists' degree of liking toward the product.

4.4.1 Organoleptic Scoring

The organoleptic scoring test was conducted to evaluate the intensity of selected sensory attributes of vegan cream cheese made with coconut milk. The attributes evaluated included color, creaminess, saltiness, savoriness, and spreadability.

The organoleptic scoring evaluation was conducted using a five-point scale. For color, the scale ranged from 1 = White, 2 = Off white, 3 = Slightly beige, 4 = Light beige, and 5 = Beige. For creaminess, the scale ranged from 1 = Very thin and not creamy mouthfeel, 2 = Slightly creamy with a thin consistency, 3 = Moderately creamy, 4 = Creamy with a smooth mouthfeel, and 5 = Very creamy with a rich and smooth mouthfeel. For saltiness, the scale ranged from 1 = Very not salty, 2 = Not salty, 3 = Moderate, 4 = Salty, and 5 = Very salty. For spreadability, the scale ranged from 1 = Very difficult to spread, 2 = Difficult to spread, 3 = Moderate, 4 = Easy to spread, and 5 = Very easy to spread. Finally, for savoriness, the scale ranged from 1 = Very not savory, 2 = Not savory, 3 = Moderate, 4 = Savory, and 5 = Very savory. The results of the organoleptic scoring test are presented in Table 8.

Table 8. Organoleptic scoring of optimized vegan cream cheese and commercial cream cheese

Sample	Color	Savoriness	Saltiness	Creaminess	Spreadability
Optimized	2.43 ± 0.50^{a}	3.13 ± 0.86^{b}	2.47 ± 0.68^{b}	3.70 ± 0.75^{b}	4.23 ± 0.90^{a}
Benchmark	2.47 ± 1.55^{a}	3.60 ± 1.50^{a}	4.67 ± 0.76^{a}	4.50 ± 0.63^{a}	4.57 ± 0.57^{a}

Note: Values are presented as mean ± standard deviation (n = 30). Different superscript letters within the same column indicate a significant difference between samples based on the Mann–Whitney U test ($p < 0.05$).

As shown in Table 8, Mann–Whitney U test indicated significant differences between the optimized vegan cream cheese and the commercial benchmark in savoriness ($p = 0.038$), saltiness ($p < 0.001$), and creaminess ($p < 0.001$). No significant differences were found in color ($p = 0.485$) or spreadability ($p = 0.170$). The optimized product had lower mean scores for savoriness (3.13 ± 0.86), saltiness (2.47 ± 0.68), and creaminess (3.70 ± 0.75) than the benchmark (3.60 ± 1.50, 4.67 ± 0.76, and 4.50 ± 0.63, respectively). The mean color scores of the optimized sample (2.43 ± 0.50) and the benchmark (2.47 ± 1.55) were statistically comparable, indicating that the addition of 3% jackfruit seed flour did not noticeably alter the visual appearance of the product. This is consistent with previous reports that plant-based cream cheese analogues can achieve color attributes similar to dairy cream cheese when using neutral-colored plant ingredients and controlled processing conditions (Sözeri Atik and Huppertz, 2025).

The lower saltiness score of the optimized sample indicates that panelists perceived it as less salty than the dairy benchmark. This difference may be associated with the salt concentration and its distribution in each product, while the food matrix can also affect salt release during oral processing. Saltiness perception is influenced not only by sodium concentration but also by moisture, fat, and product structure. The lower savoriness score may reflect differences in flavor precursors and flavor release, in line with findings that plant-based cream cheese analogues often show reduced saltiness relative to dairy references when formulated with lower sodium levels (Biscotti *et al.*, 2025). Since saltiness is a key driver of overall flavor acceptance in cream cheese, this difference may partially

explain any gap in overall liking between the optimized product and the commercial benchmark.

The lower creaminess scores for the optimized sample suggest that, although coconut milk provided fat and contributed to a creamy texture, the vegan cream cheese did not fully reproduce the rich and smooth mouthfeel of dairy cream cheese. Creaminess in cream cheese has been associated with the combined effects of fat content, lubrication properties, viscosity, and microstructure, particularly the presence of a continuous casein network in dairy systems. Studies comparing dairy and plant-based cream cheese analogues report that plant-based products often show lower creaminess and smoothness due to differences in their protein and fat networks, even when fat content is comparable (Ningtyas *et al.*, 2019; Sözeri Atik and Huppertz, 2025). The lower creaminess score observed here is therefore consistent with the use of a starch–plant protein matrix rather than a casein gel network.

Similarly, the optimized vegan cream cheese had a numerically lower spreadability score than the commercial benchmark (4.23 ± 0.90 vs. 4.57 ± 0.57), although the difference was not statistically significant. Both scores were within the 'easy to spread' range, indicating that the optimized product maintained acceptable spreadability. Spreadability in cream cheese is closely related to its rheological and textural properties, with higher firmness generally associated with reduced spreadability and lower panelist perception of ease of spreading. Previous work has shown modifications to the internal gel structure. For example, a study by Choe et al., (2025) reported that through the addition of plant-based structuring agents can

increase firmness and decrease spreadability compared with conventional cream cheese. In the present case, differences in the gel matrix formed by starch and plant proteins compared with the casein network of dairy cream cheese likely contributed to the slightly lower spreadability perception of the optimized vegan cream cheese (Sarker *et al.*, 2026).

4.4.2 Hedonic

The hedonic test was performed to evaluate the degree of panelists' preference for the developed vegan cream cheese formulations. The attributes assessed included color, creaminess, saltiness, savoriness, spreadability, and overall acceptability. The results are presented in Table 9. The evaluation was conducted using a 5-point hedonic scale: 1 = Dislike, 2 = Slightly dislike, 3 = Neutral, 4 = Slightly like, and 5 = Like.

Table 9. Hedonic evaluation of vegan cream cheese made with coconut milk at different concentrations of jackfruit seed flour and commercial cream cheese

Sample	Color	Savoriness	Saltiness	Creaminess	Spreadability	Overall
Optimized	3.63 ± 0.76^{b}	3.73 ± 0.83^{a}	3.50 ± 0.94^{a}	3.70 ± 0.75^{b}	4.13 ± 0.94^{a}	3.77 ± 0.97^{a}
Benchmark	4.30 ± 0.92^{a}	3.40 ± 1.35^{a}	3.03 ± 1.33^{a}	4.20 ± 1.10^{a}	4.40 ± 0.77^{a}	3.60 ± 1.19^{a}

Note: Values are presented as mean ± standard deviation (n = 30). Different superscript letters within the same column indicate a significant difference between the optimized formulation and the commercial benchmark according to an independent samples *t*-test ($p < 0.05$).

As shown in Table 9, Mann–Whitney U test showed significant differences in liking for color ($p = 0.001$) and creaminess ($p = 0.008$) between the optimized vegan cream cheese and the commercial benchmark. The benchmark had a higher mean color liking score (4.30 ± 0.92) than the optimized sample (3.63 ± 0.76). Similarly, the benchmark received a higher mean creaminess liking score (4.20 ±

1.10) than the optimized sample (3.70 ± 0.75). No significant differences were detected in savoriness ($p = 0.526$), saltiness ($p = 0.188$), spreadability ($p = 0.260$), or overall acceptability ($p = 0.619$). Therefore, the observed differences in liking were limited to color and creaminess.

The benchmark obtained a significantly higher color liking score (4.30 ± 0.92) than the optimized sample (3.63 ± 0.76), indicating that panelists preferred the appearance of the commercial cream cheese. This preference is likely related to the brighter and more familiar color of the dairy product, as panelists often associate these visual cues with conventional cream cheese quality. The incorporation of jackfruit seed flour has imparted a slightly darker or more cream-colored appearance to the vegan formulation (Wannasin *et al.*, 2023). Thus, it could explain the lower color liking despite the absence of a significant difference in descriptive color scores.

For savoriness, saltiness, creaminess, spreadability, and overall acceptability, no significant differences were detected between the two samples, suggesting that the perceptible differences identified in the organoleptic scoring test did not translate into reduced liking. Although the descriptive evaluation indicated that the optimized vegan cream cheese differed from the benchmark in these attributes, the hedonic evaluation shows that these differences were within an acceptable range for panelists. Panelists considered both products similarly acceptable in terms of taste, texture, ease of spreading, and overall quality. This is consistent with a report by Grossmann and McClements (2021) that plant-based cream cheese analogues

can achieve comparable overall acceptability to dairy products when key textural and flavor attributes are sufficiently matched.

Interestingly, the optimized vegan cream cheese achieved a slightly higher mean overall acceptability score (3.77 ± 0.97) than the benchmark (3.60 ± 1.19), although this difference was not statistically significant ($p > 0.05$). This finding indicates that the optimized formulation was generally well accepted by the panelists despite the perceptible differences in specific sensory attributes. Similar observations have been reported for plant-based cheese alternatives, where consumers rate some non-dairy products as equally or slightly more acceptable than dairy references when off-flavors and undesirable textural attributes (e.g., rubberiness, excessive mouthcoating) are minimized (Appiani *et al.*, 2023; Falkeisen *et al.*, 2022). In the present study, the combination of coconut milk fat, jackfruit seed flour, and the resulting gel structure appear to have produced a product that meets panelist expectations for a cream cheese-like experience.

Overall, the hedonic evaluation demonstrates that the optimized vegan cream cheese made with coconut milk achieved panelist acceptance comparable to that of the commercial benchmark, supporting its potential as a plant-based alternative to conventional cream cheese. While color preference favored the dairy product, the lack of significant differences in liking for saltiness, creaminess, spreadability, and overall acceptability suggests that the optimized formulation successfully addressed key sensory drivers of acceptance. These results align with a recent study by Falkeisen et al. (2022), indicating that plant-based dairy analogues can attain similar or, in some cases, slightly higher overall liking than dairy products when

formulation and processing are optimized to deliver familiar sensory profiles and avoid common drawbacks of plant-based systems.

CHAPTER V

CONCLUSION AND SUGGESTION

5.1 Conclusion

Based on the optimization and characterization conducted in this study, it can be concluded that the addition of 3% (w/v) jackfruit seed flour produced the optimum formulation of coconut milk-based vegan cream cheese. Characterization of the optimum formula showed significantly higher moisture, protein, and fat contents but significantly lower ash and carbohydrate contents than the commercial benchmark. Sensory evaluation demonstrated that the optimized vegan cream cheese achieved favorable panelist acceptance, with sensory characteristics comparable to those of commercial dairy cream cheese.

5.2 Suggestion

Future studies are recommended to further investigate the structural characteristics of vegan cream cheese made with coconut milk through comprehensive microstructural and rheological analyses to better explain the relationship between the starch network formed by jackfruit seed flour and the coconut milk matrix and the resulting texture properties. In addition, evaluation of the physicochemical, microbiological, textural, and sensory stability during refrigerated storage is recommended to determine product quality changes and shelf life, thereby providing a more comprehensive characterization of the developed vegan cream cheese.

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