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Supplementation of Antioxidant Liang Tea Extracts on Goat Milk Cream Cheese

Suplementasi Ekstrak Antioksidan Liang Teh pada Cream Cheese Susu Kambing

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Abstract

Cream cheese is a soft cheese that does not go through a ripening process and is widely used in various kinds of food preparations. Goat's milk is an alternative milk for cream cheese production. The addition of antioxidant extract from liang tea potentially produces functional cream cheese. This research aimed to obtain the concentration of added antioxidant liang tea extract in the formulation that produces the best characteristics of goat's milk cream cheese. This research used a Randomized Block Design method with one factor: the concentration of liang tea extract as an antioxidant. The treatment consisted of 5 levels of liang tea concentrations, 0%, 1.5%, 2%, 2.5%, and 3%, with five repetitions. The research showed that adding various concentrations of liang tea antioxidant extract produced a water content of 61.06%-62.09% and a fat content of 12.68%-14.46%. The resulting color characteristics with the L* value range from 60.83-76.43 (decreasing brightness), the* value range from -6.69-6.71 (reddish), and the b* value range from 4.47-23 .88 (yellowish). Antioxidant activity is expressed by percent inhibition of 1,1-diphenyl-2-picrylhydrazil (DPPH), ranging from 36.00%-79.56%. The antioxidant activity of goat's milk cream cheese increases if the addition of liang tea extract is high. Based on the effectiveness index, the best goat's milk cream cheese is produced by adding a 3% concentration of liang tea. The cream cheese has a water content of 62.19%, a fat content of 14.46%, color (L* = 60.83, a* = 6.71, b* = 23.88), and antioxidant activity of 79.56%.
Keywords: antioxidant, cream cheese, goat milk, liang tea

Abstrak

Cream cheese *merupakan salah satu jenis keju lunak yang tidak melalui proses pematangan dan banyak diaplikasikan pada berbagai macam olahan pangan. Susu kambing menjadi alternatif susu untuk* membuat cream cheese*. Penambahan ekstrak antioksidan dari liang teh berpotensi untuk membuat* cream cheese *fungsional. Tujuan penelitian ini untuk memperoleh konsentrasi penambahan ekstrak antioksidan liang teh dalam formulasi yang menghasilkan karakteristik* cream cheese *susu kambing terbaik. Penelitian ini menggunakan Rancangan Acak Kelompok (RAK) dengan satu faktor, yaitu konsentrasi ekstrak liang teh sebagai antioksidan. Perlakuan yang dilakukan terdiri dari 5 taraf, yaitu 0%, 1,5%, 2%, 2,5% dan 3% dengan 5 kali ulangan. Hasil penelitian menunjukkan penambahan berbagai konsentrasi ekstrak antioksidan liang teh menghasilkan kadar air pada rentang 61,06%-62,09% dan kadar lemak pada rentang 12,68%-14,46%. Karakteristik warna yang dihasilkan dengan rentang nilai L* adalah 60,83-76,43 (kecerahan menurun), nilai a* pada rentang -6,69-6,71 (kemerahan), dan nilai b* pada rentang 4,47-23,88 (kekuningan). Aktivitas antioksidan dinyatakan dengan persen penghambatan 1,1-diphenyl-2-picrylhydrazil (DPPH) pada rentang 36,00%-79,56%. Aktivitas antioksidan* cream cheese *susu kambing semakin meningkat jika penambahan ekstrak liang teh semakin tinggi.* Cream cheese *susu kambing terbaik berdasarkan indeks efektivitas dihasilkan dengan penambahan konsentrasi liang teh 3%*. Cream cheese *tersebut mempunyai kadar air 62,19%, kadar lemak 14,46%, warna (L* = 60,83, a* = 6,71, b* = 23,88), dan aktivitas antioksidan 79,56%.*
Kata kunci: *antioksidan,* cream cheese*, liang teh, susu kambing*

INTRODUCTION

Milk is known as liquid food with high nutritional content, but its quality is quickly degraded, resulting in physical and chemical damage. Processing milk into cheese is one of the efforts to overcome it. Cheese is a popular food produced and consumed globally made from milk. Cheese has a variety of

tastes, textures, and shapes based on the process and ingredients used (Fox et al., 2017). The curd formation mechanism in cheese production is based on the precipitation of milk proteins with acids, enzymes, or fermentation using lactic acid bacteria (Sugitha et al., 2016). Cheese is divided into several types based on its texture: soft, semi-soft, and hard (Fatharani et al., 2018).

Soft cheese is a cheese that does not continue to become mature, for example, cream cheese. This cheese is generally applied as a spread on bread, accompaniment to sandwiches, mixed dishes, salad dressings, and snacks. Cream cheese has a soft, light texture, bright white color, slightly sour taste, and is easy to spread (Correia et al., 2022). Cream cheese is obtained from milk coagulation or curd formation by acidifying the milk (Guna et al., 2020). Goat's milk can be used to make cream cheese.

Goat's milk generally consists of macronutrients, such as 4% fat, 87% water, 4.5% carbohydrates, 3.5% protein, 1% ash, and medium chain fatty acids (caprylic, capric, and caproic acid) which help reduce cholesterol (Nayik et al., 2022). Goat milk has a small fat globule size, so its digestibility is better than cow and buffalo milk (Kalyan et al., 2018). Functional cream cheese innovations can be made by adding antioxidant components. Antioxidants are inhibitors of the oxidation process that is essential for the body. Various antioxidants that fight free radicals can be found in food sources such as fruit, vegetables, and tea (Yadav et al., 2016).

Liang tea is a natural ingredient that contains antioxidants and can be added to cream cheese products. According to Dewi et al. (2022a), Liang tea is a decoction consisting of tea ingredients and herbal ingredients containing phenolic antioxidant components. The tea ingredient is sappanwood (*Biancaea sappan*), while the herbal ingredients include Chinese foldwing leaves (*Dicliptera chinensis*), rhoeo discolor (*Tradescantia spathacea*), oregano leaves (*Origanum vulgare* Wilder), pandan leaves (*Pandanus amaryllifolius)* and aloe vera rind (*Aloe chinensis* L.). According to Dewi (2022a), the antioxidant activity using the 1,1-diphenyl-2-picrylhydrazil (DPPH) method found in tea leaves is 40.38%, which includes alkaloid, flavonoid, phenol, tannin, and terpenoid components. Previous research developed cream cheese products using pomegranate peel extract (El-shafei et al., 2017), *Hibiscus sabdariffa* flower extract (Nugroho et al., 2018), and *Amorphophallus muelleri* flour (Guna et al., 2020). Using liang tea is expected to add functional benefits, especially the antioxidant content in goat's milk cream cheese. This research aimed to obtain the added liang tea concentration in the formulation to produce the best characteristics of goat's milk cream cheese.

METHODS

Apparatus and Materials

The tools, equipment, and apparatus used in this research were basins, cutting boards, knives, blenders, 60 mesh sieves, analytical balance (Mettler Toledo), cabinet dryers (Control egp (IL-80EN)), hotplates, magnetic stirrers, thermometers, UV-VIS spectrophotometers (Shimadzu UV mini-1240), desiccator, digital colorimeter AMT506, oven (Phillip Harris Ltd), Erlenmeyer (IWAKICTE33), beaker glass (IWAKICTE33), crucible cup, measuring cylinder (IWAKICTE33), petri dish, filter cloth, aluminum foil, clamp wood, centrifuge, test tube, micropipette (Socorex Swiss), and pH meter.

The material used in this research was goat's milk (obtained from Tazzayad Farm located on Jl. BTN Permai No.527-525, West Pontianak District, Pontianak City, West Kalimantan Province), citric acid, +Qso brand rennet (obtained from an online shop), salt, tea leaves, tofu filter cloth, and tea bags. The ingredients used in making Liang tea are sappanwood, Chinese foldwing leaves, aloe vera rind, rhoeo discolor leaves, oregano leaves, pandan leaves (obtained from the Pontianak traditional market), water, and distilled water (obtained from the Kalimantan Research shop). The materials used for analysis were methanol pro analysis and DPPH from Sigma Aldrich (obtained from the Dwi Occitanie shop on Jl. Tabrani Ahmad, Gg. Serumpun 2 No. A15, Pontianak, Indonesia).

Research Design

The research design used the Randomized Block Design method. The factor tested in the research was the concentration of added liang tea. This study applied five different treatment levels: liang tea concentrations of p1 (0%), p2 (1.5%), p3 (2%), p4 (2.5%), and p5 (3%), with each treatment level repeated five times.

Liang Tea Production

The process of liang tea production refers to Dewi (2022b). The ingredients for liang tea are sappanwood, Chinese foldwing leaves, aloe vera rind, rhoeo discolor leaves, oregano leaves, and pandan leaves are rinsed under running water until clean. All the ingredients are then drained and weighed. All materials are dried by spreading them on cabinet drying racks at a temperature of 60 °C until the moisture content reaches 8%. The dry ingredients were ground using a blender and then sieved with a 60-mesh sieve. The finely ground dry material is weighed and stored in a closed container. The liang tea ingredients used are listed in Table 1.

Table 1. Formulation of liang tea ingredients

No	Liang Tea Ingredients (Dry Ingredients)	Quantity (g)
1.	Chinese foldwing leaves (*Dicliptera chinensis*)	0.5
2.	Oregano leaves (*Origanum vulgare* Wilder)	0.05
3.	Aloe vera rind (*Aloe chinensis* L.)	0.05
4.	Rhoeo discolor (*Tradescantia spathacea*)	0.125
5.	Pandan leaves (*Pandanus amaryllifolius*)	0.05
6.	Sappanwood (*Biancaea sappan*)	0.225
	Total ingredients	1

The Production of Liang Tea Goat Milk

The process of brewing liang tea goat's milk refers to the modified research by Dewi (2022b). The liang tea ingredients are weighed according to the formulation and then put into a tea bag. The tea bag was transferred to a beaker glass containing goat's milk at a temperature of 80 °C-90 °C (Table 2). The tea bag is then brewed and stirred with a magnetic stirrer for 10 minutes. The brew is left for 30 minutes to reduce residue.

Cream Cheese Production

The cream cheese production refers to modified research by Guna et al. (2020). Liang tea goat's milk (Table 2) was heated to 63 °C for 30 minutes, then lowered to 40 °C. The results were filtered using a tofu filter cloth and then taken by 150 mL. Citric acid and rennet were added to the tea liang goat's milk (Table 3) and left at room temperature until curd formed. The pH then decreases from 4.6 to 4.8. The formed curd was heated again until it reached a temperature of 50 °C. The mixture is filtered and drained using a filter cloth for 24 hours to separate the curd and whey, and then the whey is discarded. Salt is added as much as 0.5% of the total curd produced.

Table 2. Liang tea goat's milk formulation

Liang Tea Goat's Milk	Goat's Milk		Liang Tea	
	g	%	g	%
p1	200	100.0	0	0.0
p2	197	98.5	3	1.5
p3	196	98.0	4	2.0
p4	195	97.5	5	2.5
p5	194	97.0	6	3.0

Table 3. Ingredients formulation for cream cheese production

Ingredients	Formulation of Cream Cheese in Various Liang Tea Goat's Milk				
	p1	p2	p3	p4	p5
Liang tea goat's milk (mL)	150	150	150	150	150
Citric acid (g)	0.75	0.75	0.75	0.75	0.75
Rennet (g)	0.0015	0.0015	0.0015	0.0015	0.0015
Salt (%)	0.5	0.5	0.5	0.5	0.5

Source: Guna et al. (2020)

Water Content Analysis

Water content analysis was performed using the gravimetric method (AOAC, 2019). The empty crucible cup was heated in an oven at 105 ℃ for 30 minutes and then cooled in a desiccator for 15 minutes. The cooled crucible cup is weighed (W_0). The empty crucible cup was filled with 2 g of sample and weighed again (W_1). The sample in the crucible cup was dried using an oven at 105 ℃ for 3 hours and then cooled in a desiccator for 15-30 minutes. The crucible cup and contents were weighed and dried again for 1 hour at 105 ℃, then cooled in a desiccator. The results are weighed again. Drying, cooling, and weighing were carried out repeatedly until the weight was constant (W_2). Water content is calculated using the equation:

$$\text{Water content (\%)} = \frac{W_1\text{-}W_2}{W_1\text{-}W_0} \times 100\% \quad (1)$$

Where,
W_0 = empty crucible cup weight (g)
W_1 = crucible cup weight + sample before drying (g)
W_2 = crucible cup weight + sample after drying (g)

Fat Content Analysis

Fat content analysis was performed using the Soxhlet method. The boiling flask is placed in the oven at 100 °C-105 °C for 30 minutes. The boiling flask was then cooled in a desiccator to remove water vapor and weighed (A). Samples weighing 2 g (B) were wrapped in filter paper lined with fat-free cotton on the outside. The sample wrapped in filter paper and cotton is placed in a Soxhlet extraction apparatus connected to the boiling flask, and its weight is determined. The chloroform solvent is poured until the sample is submerged, and fat extraction is carried out for 5-6 hours. The fat solvent that has been used is distilled and stored. The fat extract in the boiling flask was dried using an oven at 100 ℃-105 °C for 1 hour, then the boiling flask was cooled in a desiccator and weighed (C). Fat content is calculated using the equation (AOAC, 2019):

$$\text{Fat content (\%)} = \frac{C\text{-}A}{B} \times 100\% \quad (2)$$

Where,
A = empty boiling flask weight
B = sample weight
C = boiling flask and extracted fat weight

Color Analysis

Color is determined based on the Commission internationale de l'éclairage (CIE) system. The equipment used to measure the color of goat's milk cream cheese is the AMT 507 CIElab system chromameter: L* (brightness), a* (reddish or greenish), b* (yellowish or bluish) (Wang et al., 2019). Sample measurements were performed by attaching the Chromameter optical head to a petri dish containing goat's milk cream cheese, and then the start button was pressed. Grouping using L*, a*, and b* color space segmentation aims to identify color content digitally. L* represents the brightness level with a value of 0-100 (black and white). The a* represents the color type with a negative value for green (0 - (-80)) and a positive for red (0 – 80). The b* represents the type of color with a negative value for blue (0 – (-70)) and a positive for yellow (0 – 70) (Sinaga, 2019).

Analysis of Antioxidant Activity Using the DPPH Method

Antioxidant activity was determined, referring to research by El-shafei et al. (2017). A 0.1 g cream cheese sample was homogenized using 5 mL of methanol. The mixture was centrifuged at 5000 rpm for 15 minutes. The solution obtained after centrifugation was taken at 0.5 mL, and then 1 mL of DPPH solution and 1.5 mL of methanol solution were added. Controls were prepared by adding DPPH (1.5 mL) to methanol (1.5 mL). The antioxidant activity of cream cheese was determined after 30 minutes by reading the absorbance at a wavelength of 517 nm. Antioxidant activity (%) was calculated using the following equation:

$$\text{Antioxidant (\%)} = \frac{\text{Abs control-Abs sample}}{\text{Abs control}} \times 100\% \quad (3)$$

Where,
Abs control = absorbance control
Abs sample = absorbance sample

Data Analysis

Data were analyzed using the Analysis of Variance (ANOVA) method. If the treatment has a significant effect, further tests are carried out using Tukey's Honest Significant Difference (HSD) test at the 5% level. The best treatment determination was performed using DeGarmo et al. (1984) effectiveness index test method on each research parameter based on standards and level of importance or contribution. The researcher assigned each research parameter weight with a score of 0-1. Determining the weight of these parameters depends on their respective interests as the treatment result. The highest average of the parameter measurement results is the best value, and the lowest average is the worst value. This condition differs in parameter value; it gets better when the value is low. The average of the lowest parameter measurement results is the best value, and the average of the highest parameter measurement results is the worst value. The normal weight of the ith parameter is determined by the equation:

$$NW_i = \frac{\sum_{i=1}^{p} PW_i}{p} \quad (4)$$

The effectiveness index value for each parameter in each treatment is then calculated using the equation:

$$EI_{ij} = \frac{MP_{ij} - WP_1}{BP_1 - WP_1} \quad (5)$$

The treatment value of each parameter in each treatment is calculated using the equation:

$$TV_{ij} = EI_{ij} * NW_i \quad (6)$$

The total treatment value for each treatment is then calculated using the equation:

$$TTV_j = \sum_{i=1}^{p} TV_{ij} \quad (7)$$

Where,
NW_i: normal weight of the i^{th} parameter
p: the number of parameters
PW_i: weight of the i^{th} parameter
EI_{ij}: effectiveness index value of the i^{th} parameter in the j^{th} treatment
MP_{ij}: average measurement results of the i^{th} parameter in the j^{th} treatment
WP_i: the lowest average value of the i^{th} parameter measurement results
BP_i: the highest average value of the i^{th} parameter measurement results
TV_{ij}: treatment value of the i^{th} parameter in the j^{th} treatment
TTV_j: total treatment value in the j^{th} treatment
The best treatment is the treatment with the highest TTV_j.

RESULTS AND DISCUSSION

Water Content

Water content is an essential factor in a food product, influencing its texture, appearance, taste, and shelf life (Winarno, 2004). Water content analysis aims to determine the water content in cream cheese products. Measuring the water content in food can be determined using the gravimetric method. The higher the water content, the softer the cheese texture will be. Table 4 shows the ANOVA results of the water content of goat's milk cream cheese with the addition of liang tea. The average water content of goat's milk cream cheese with the addition of tea can be seen in Table 5.

The ANOVA results (Table 4) with a significance level of 5% showed that the addition of liang tea had no significant effect ($P<0.05$) on the water content of goat's milk cream cheese, so the HSD test was not continued. The water content of goat's milk cream cheese with the addition of liang tea extract in the milk was 61.06% -62.19% (Table 5). The volume of liang tea extract replaces the volume of milk so that the total volume does not change. The low water content of dry liang tea extract (around 8%) is thought not to influence the coagulation process of goat's milk cream cheese, so the water content of the final

product has no significant effect. Water content is thought to be related to coagulants. The coagulants used in this research were citric acid and rennet, with the same composition in all treatments. According to Arifiansyah et al. (2014), the difference in cheese water content is also thought to be caused by the water presence in the cheese, which is in three parts: bound in the structure of the curd components, retained in the hygroscopic curd particles, and as free water.

Table 4. ANOVA of water content from goat's milk cream cheese with the addition of liang tea

Source of Variations (SV)	Degrees of Freedom (DF)	Sum of Square (SS)	Mean Square (MS)	F Value (%)	F Table 5%
Treatment	4	3.62	0.90	0.23^{ns}	3.01
Group	4	18.16	4.54	1.14	3.01
Error	16	63.78	3.99		
Total	24	85.55			

ns : not significantly different

Table 5. Water content of goat's milk cream cheese with the addition of liang tea

Liang Tea Concentration in Goat Milk (%)	Liang Tea Goat Milk Cream Cheese Water Content (%)
0.0	61.95 ± 0.97
1.5	61.63 ± 2.41
2.0	61.75 ± 3.28
2.5	61.06 ± 1.30
3.0	62.19 ± 1.13

Fat Content

The fat content analysis aims to determine the amount of fat contained in goat's milk cream cheese with the addition of liang tea. Fat content can influence the cheese quality. Table 6 shows the ANOVA results of the fat content of goat's milk cream cheese with the addition of liang tea. The results of the dry base fat content of goat's milk cream cheese with the addition of liang tea can be seen in Table 7.

Table 6. ANOVA of fat content from goat's milk cream cheese with the addition of liang tea

Source of Variations (SV)	Degrees of Freedom (DF)	Sum of Square (SS)	Mean Square (MS)	F Value (%)	F Table 5%
Treatment	4	9.23	2.31	0.98^{ns}	3.01
Group	4	16,.80	4.20	1.78	3.01
Error	16	37.81	2.36		
Total	24	63.85			

ns : not significantly different

Table 7. Fat content of goat's milk cream cheese with the addition of liang tea

Liang Tea Concentration in Goat Milk (%)	Liang Tea Goat Milk Cream Cheese Fat Content (%)
0.0	13.08 ± 1.38
1.5	12.83 ± 1.29
2.0	14.09 ± 1.78
2.5	13.68 ± 1.89
3.0	14.46 ± 1.83

The results of ANOVA with a significance level of 5% showed that adding liang tea had no significant effect on the fat content of goat's milk cream cheese (Table 6), so it was not continued in the HSD test. The fat content of goat's milk cream cheese with the addition of liang tea was 12.83% -14.46% (Table 7). A factor that can influence the fat content of goat's milk cream cheese is the protein content in

goat's milk (Fangmeier et al., 2019). The quantity of fat that can be bound and retained in cheese increases if the protein content in the cheese is high, so the fat content of the cheese is high (Sunarya et al., 2016). The source of protein and fat in this study was goat's milk, and its concentration was not considered as a tested factor for its effect on goat's milk cream cheese, while the fat content of liang tea was 0.08% (Dewi et al., 2022a). Research conducted by Fangmeier et al. (2019) shows that goat's milk produces a 4.00 ± 0.06% fat content of goat's milk cream cheese, which is lower than the results of liang tea goat's milk cream cheese. Adding liang tea containing antioxidant compounds to goat's milk cream cheese is expected to impact inhibiting lipid oxidation, which is the most significant component of cream cheese. Antioxidant compounds can contribute to slowing down the lipid oxidation process (El-shafei et al., 2017).

Color

The results of ANOVA at the 5% level showed that the addition of tea liang concentration had a significant effect on the color profile of goat's milk cream cheese (Table 8), so an HSD test was carried out, and the results are shown in Table 9. The HSD test results (Table 9) show that adding liang tea concentration in goat's milk produces a color profile of goat's milk cream cheese significantly different in the L*, a*, and b* values (α = 5%). The L* value range is 60.83-76.43. The L* value decreases if the concentration of liang tea in goat's milk is high. This result shows that adding liang tea to goat's milk to produce cream cheese can reduce the brightness of goat's milk cream cheese. These results follow research by El-shafei et al. (2017), who added pomegranate peel extract to produce cream cheese. The L* value decreases if the concentration of pomegranate peel extract is high.

Table 8. ANOVA of goat's milk cream cheese color with the addition of liang tea

L*					
Source of Variations (SV)	**Degrees of Freedom (DF)**	**Sum of Square (SS)**	**Mean Square (MS)**	**F Value (%)**	**F Table 5%**
Treatment	4	756.63	189.16	73.82*	3.01
Group	4	28.70	7.18	2.80	3.01
Error	16	41.00	2.56		
Total	24	826.33			
a*					
Source of Variations (SV)	**Degrees of Freedom (DF)**	**Sum of Square (SS)**	**Mean Square (MS)**	**F Value (%)**	**F Table 5%**
Treatment	4	203.40	50.85	19.84*	3.01
Group	4	7.65	1.91	0.75	3.01
Error	16	15.10	0.94		
Total	24	226.15			
b*					
Source of Variations (SV)	**Degrees of Freedom (DF)**	**Sum of Square (SS)**	**Mean Square (MS)**	**F Value (%)**	**F Table 5%**
Treatment	4	473.28	118.32	46.17*	3.01
Group	4	0.81	0.20	0.08	3.01
Error	16	24.37	1.52		
Total	24	498.37			

* = significantly different

The a* value for goat's milk cream cheese is -6.69 – 6.71, indicating that the cream cheese's color tends to be red. The b* value for goat's milk cream cheese is 4.47 – 23.88, indicating that the cream cheese's color tends to be yellow. Adding liang tea brewing extract to goat's milk increases the values of a* and b*. Increasing the liang tea concentration increases the reddish (a*) and yellowish (b*) color in goat's milk cream cheese. According to Dewi et al. (2022b), the color of liang tea is brownish purple. This color is a combination of colors produced from anthocyanin compounds from rhoeo discolor (*Tradescantia spathacea*) and Chinese foldwing leaves (*Dicliptera chinensis*) and brazilin compounds

from sappanwood (*Biancaea sappan*). These compounds produce water-soluble pigments that are naturally found in various types of plants.

Table 9. Color profile of goat's milk cream cheese with the addition of liang tea

Liang Tea Concentration in Goat Milk (%)	Liang Tea Goat Milk Cream Cheese Color Profile		
	L*	a*	b*
0.0	76.43 ± 0.71^{d}	-6.69 ± 0.22^{a}	4.47 ± 0.56^{a}
1.5	66.34 ± 2.26^{c}	2.60 ± 1.64^{b}	17.86 ± 1.56^{b}
2.0	65.01 ± 3.11^{bc}	4.02 ± 0.99^{bc}	22.00 ± 0.96^{c}
2.5	62.16 ± 1.13^{ab}	5.42 ± 0.88^{d}	23.46 ± 0.87^{c}
3.0	60.83 ± 1.56^{a}	6.71 ± 1.09^{cd}	23.88 ± 1.37^{c}
HSD 5%	3.10	1.88	2.39

Numbers followed by different letters indicate significantly different results in the 5% HSD test

Antioxidant Activity

Antioxidants are compounds that can inhibit, delay, or prevent oxidation (Santoso, 2021). Determination of antioxidant activity in this study used the DPPH radical absorption method using a spectrophotometer. DPPH provides strong absorption at a wavelength of 517 nm with a dark violet color (Lung & Destiani, 2018). The percentage of antioxidants is influenced by the phenolic compounds in a material (Ginting & Husni, 2020).

The ANOVA results on the antioxidant activity of goat's milk cream cheese with the addition of liang tea are shown in Table 10. The ANOVA results at the 5% level show that adding liang tea concentration in goat's milk significantly affects the antioxidant activity value of the liang tea goat's milk cream cheese produced, so it continues with the HSD test. The antioxidant activity value of liang tea goat's milk cream cheese is 36.00%-79.56%. The highest antioxidant activity value was the cream cheese with a 3% concentration of liang tea in goat's milk.

Table 10. ANOVA analysis of the antioxidant activity of goat's milk cream cheese with the addition of liang tea

Source of Variations (SV)	Degrees of Freedom (DF)	Sum of Square (SS)	Mean Square (MS)	F Value (%)	F Table 5%
Treatment	4	5441.71	1360.43	127.89*	3.01
Group	4	30.85	7.71	0.72	3.01
Error	16	170.20	10.64		
Total	24	5642.75			

* = significantly different

Table 11. Antioxidant activity of goat's milk cream cheese with the addition of liang tea

Liang Tea Concentration in Goat Milk (%)	Antioxidant Activity of Liang Tea Goat's Milk Cream Cheese (%)
0.0	36.00 ± 1.01^{a}
1.5	56.02 ± 1.26^{b}
2.0	63.25 ± 4.93^{c}
2.5	70.43 ± 2.22^{d}
3.0	79.56 ± 3.04^{e}
HSD 5% = 6.31	

Numbers followed by different letters indicate significantly different results in the 5% HSD test

The results of this study (Table 11) show that antioxidant activity increases if the concentration of liang tea added to goat's milk cream cheese is high. The increase of antioxidant activity in goat's milk cream cheese is caused by the increase of phenolic compounds from liang tea. According to Dewi (2022b), liang tea contains phytochemicals, such as alkaloids, flavonoids, phenols, tannins, and terpenoids. The antioxidant activity of goat's milk cream cheese is also influenced by the antioxidant

activity of goat's milk. Alyaqoubi et al. (2014) stated that the antioxidant activity of goat's milk is 55.29%-64.77%.

El-shafei et al. (2017) showed that adding pomegranate peel extract to cream cheese production significantly impacted its antioxidant activity. This research's cream cheese antioxidant activity increased if the addition of pomegranate peel extract increased. Nugroho et al. (2018) reported that the antioxidant content of fresh cheese increased if the concentration of purple rosella extract added increased. This result is because rosella flowers contain anthocyanin compounds.

Best Treatment Determination

The best treatment for goat's milk cream cheese with the addition of liang tea is done by giving weight to each parameter based on standards and level of importance. The weight of each parameter of goat's milk cream cheese with the addition of liang tea can be seen in Table 12. The Treatment Value (TV) is then calculated, and the results are shown in Table 13. According to DeGarmo et al. (1984), the best treatment is the treatment with the highest TV.

Table 12. Parameter weight of goat's milk cream cheese with the addition of liang tea

Parameter	Parameter Weight
Antioxidant Activity	1.0
Color L*	0.9
Color a*	0.9
Color b*	0.9
Water content	0.8
Fat content	0.7

Table 13. The best treatment value for goat's milk cream cheese with the addition of liang tea

Parameters	WP	NW	Liang Tea Concentration in Goat Milk (%)									
			0		1.5		2		2.5		3	
			EI	TV	EI	TV	EI	TV	EI	TV	EI	TV
Antioxidant Activity	1	0.192	0	0	0.460	0.088	0.626	0.120	0.790	0.152	1.000	0.192
Color L*	0.9	0.173	1.000	0.173	0.353	0.061	0.268	0.046	0.085	0.015	0	0
Color a*	0.9	0.173	0	0	0.693	0.120	0.799	0.138	0.904	0.156	1.000	0.173
Color b*	0.9	0.173	0	0	0.561	0.097	0.734	0.127	0.795	0.138	1.000	0.173
Water content	0.8	0.154	0.788	0.121	0.506	0.078	0.608	0.094	0	0	1.000	0.154
Fat content	0.7	0.135	0.155	0.021	0	0	0.770	0.104	0.520	0.070	1.000	0.135
TTV	5.2			0.315		0.444		0.629		0.531		**0.827**

TTV in bold indicates the best treatment value based on the effectiveness index test

The results showed that the highest treatment value was the addition of liang tea with a concentration of 3% in goat's milk cream cheese production. The goat's milk cream cheese has an average water content = 62.19%, fat content = 14.46%, color L* = 60.83, a* = 6.71, b* = 23.88, and antioxidant activity = 79.56%.

Managerial Implications

This research provides important opportunities for the cream cheese industry to increase nutritional value and product differentiation. The utilization of antioxidant liang tea extract in goat's milk cream cheese not only enriches the health aspect of the product but also provides uniqueness in a competitive market. Food design that focuses on product quality-based management, including developing formulas that consumers prefer and improving physicochemical quality, companies can target broader market segments, including consumers who prioritize health and natural preferences. An efficient marketing strategy should emphasize the product's uniqueness and health benefits.

Sustainable and innovative product development is the key to implementing the results of this research. Integrating liang tea extract into cream cheese supports the management initiation of goat's milk-based products, which can be developed on a small scale, such as by small and medium business groups with limited capital. This condition adds value to the product and drives innovation in the industry.

Collaboration with research institutions will increase innovation and product development capabilities and ensure the company remains ahead of market trends and meets consumer needs.

Using raw materials and environmentally friendly production methods is also essential to consider. Managerial use of liang tea made from Indonesian herbal ingredients not only streamlines the availability of raw materials but can also reduce production costs and increase efficiency. Management needs to ensure that the source of raw materials for liang tea extract and goat's milk is obtained sustainably, supports environmental sustainability, and improves the company's image. Worker training and development must also be carried out to adapt to new technology and production processes.

CONCLUSIONS

This research shows that adding various concentrations of liang tea antioxidant extract produces goat's milk cream cheese with a water content of 61.06%-62.19% and a fat content of 12.83%-14.46%. The color characteristics of goat's milk cream cheese are L* = 60.83-76.43, a* = (-6.69) – 6.71, and b* = 4.47-23.88. Antioxidant activity is expressed by the percentage of DPPH inhibition, 36.00%-79.56%. If the liang tea extract addition is high, the more significant antioxidant activity of goat's milk cream cheese. The addition of liang tea with a concentration of 3% in the production of goat's milk cream cheese produces the best characteristics of goat's milk cream cheese with a water content of 62.19%, fat content of 14.46%, color L* 60.83, a* 6.71, b* 23.88, and antioxidant activity 79.56%. This research needs to be complemented by an economic feasibility test and tested in various field conditions to determine the total commercialization valuation and technological readiness level.

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