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Effect of substituting cow milk with saga bean (*Adenanthera pavonina*, Linn) milk during the processing of saga soft cheese

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Abstract

This study aimed to optimize the substitution of cow milk with saga bean milk for the production of saga soft cheese (SSC). The design of the experiment was completely random. In the five formulae used, the ratio of saga milk: cow's milk (v/v), consecutively referred to as F3, F4, F5, F6 and F7 are as follows: 80:20; 70:30; 60:40; 50:50; 40:60. The enzyme and starter cheese culture used in this experiment were the same as those used for manufacturing commercial soft cheese. The experiment was performed four times, and the parameters measured were clotting time, yield, texture profile analysis and a preference test. We observed that 50% and 40% substitution of cow milk substitution with saga bean milk was optimal for producing SSC. The formulae did not differ significantly ($p<0.05$) in terms of clotting time, and yield obtained, and the highest percentage of sensory value response was 90%. As a result, the product was highly accepted by the panellists and required slight improvement in sensory parameters. The five parameters in the texture profile analysis, hardness, cohesiveness, gumminess, springiness and chewiness, differed significantly ($p<0.05$). The maximum utilization of saga milk, which was acceptable in terms of the process, yield and sensory value was F6 (50% saga milk: 50% cow milk). The selected product had a clotting time for 67±2.12 min, a yield of 21.31±3.88%, and texture with a hardness of 49.58±3.23 gf, the cohesiveness of 0.91±0.05 and springiness of 0.71±0.04 mm. The use of saga milk up to 50% for manufacturing of SSC is recommended to produce a product, it has passed the sensory test of panellists.

1. Introduction

The demand for cheese in Indonesia is increasing, and the report shows that the sales of cheese per year are increasing by 15-25% (Aimon and Satrianto, 2014). A healthy lifestyle is a new trend for the world community, which encourages researchers to create healthy foods. Reducing the use of cow's milk and increasing the use of plant material in cheese manufacturing is highly desirable, due to the high cholesterol content in the former. This has shifted the focus on the advantages of using natural resources other than cow's milk. For example, cheese has been derived from corn extract (Aini *et al*., 2020), and from soy milk and coconut milk using various coagulants (Ayodeji *et al*., 2020), and processed cheese has been enriched with various vegetable powders (Farahat *et al*., 2021). Analog cheese made from corn extract has a higher beta carotin (reaching 544.4 mg/g) than cheese derived from cow's milk (only 5.32 mg/g) (Aini *et al*., 2020). Farahat *et al*. (2021) reported that the addition of processed cheese enriched with vegetable powders blend (potato, mushrooms, pumpkin, carrots, chickpeas, green beans, celery, scallions, dill and parsley) in ratios of 5% and 7.5% was sufficient to create functional food that was sensorily acceptable to all panellists. A recent study reported that many types of vegetable-based cheeses have been developed in the USA, and cashew-based cheeses appeared to have a better nutritional profile (Craig *et al.,* 2022).

Soybean is a vegetable protein that can be converted into soy milk. The use of soy protein in various dairy products has been widely studied. For example, soy-based gouda cheese analogues are available (Amar and Surono, 2012), and the use of soy protein isolate in the cheddar cheese can improve the quality of cheddar cheese (Mahdy *et al*., 2004). Developments of soy

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cheese-like products have been reported by Jeewanthi and Paik (2018), who have described various types of cheese, manufactured using microbial enzyme coagulants from various types of plants as well as rennet, which is conventionally used for manufacturing cow's milk-based cheese. Soy protein in soy milk is used in the form of flour such as soy protein isolate (SPI) or soy protein concentrate (SPC). Soy protein can be used as a functional food (Jooyandeh, 2011), or to make cheese products that are relatively inexpensive, good for lactose-intolerance people, and high nutritive value (Jeewanthi and Paik, 2018).

Another plant that may be potentially used in dairy products is the seed of saga plants (*Adenanthera pavonina,* Linn). Saga is a tree-shaped tropical plant that can grow well on all types of soil. The protein content of saga bean is comparable to that of soybeans, and thus saga bean milk may be used in dairy products. Yenrina *et al*. (2014), reported that the production of saga bean milk mixed with sesame milk resulted in a good taste of the product. Saga bean has been used as raw material for producing fermented products such as Tempeh (Amar, 2020), yoghurt based on saga milk (Amar, Makosim, Anggraeni *et al*., 2021), and Tauco saga (Amar, Makosim, Sukotjo *et al*., 2021). Saga milk-based fresh cheese suitable for consumption has been reported by Amar *et al*. (2017). However, the effect of adding cow's milk on the texture of fresh cheese is not known.

Various saga oils that are beneficial for health are produced during saga seed extraction. Saga bean oil is rich in long-chain fatty acids (unsaturated and saturated) which are not present in soybean; for example, gadoleic acid, erucic acid and nervonic acid are the long chains of unsaturated acids, while lignoseric acid is a saturated long-chain acid present in saga bean oil (Sultana and Guzlar, 2012). Consumption of roasted saga seeds can reduce the risk of obesity, as they contain many fatty acids (long-chain saturated and unsaturated fatty acids) as well as tocopherol compounds and mineral compounds (Huml *et al*., 2020)

In this study, we aimed to manufacture a soft cheese -like product based on saga bean milk and determine the possibility of developing products that can be accepted by panellists, especially in terms of texture and other sensory attributes. In particular, the percentage of cow's milk that could be replaced by saga bean milk during the processing of soft cheese and how the manufacturing of saga soft cheese affects its texture and sensory properties. It was hoped that this soft cheese substituted with cow's milk had a soft cheese texture and sensory properties were investigated. We hope that this soft-textured cheese produced by substituting cow's milk can be used as a spread on bread, thereby increasing the number of diversified products that can be manufactured from processed saga beans.

2. Materials and methods

Ripped saga bean seed (*Adenanthera pavonina*, Linn) was obtained from the plants in the area in Institut Teknologi Indonesia, Serpong, Tangerang Selatan, Indonesia. Full cream cow milk, homogenized and pasteurized was purchased from a local supermarket and was produced by PT. Diamond, Indonesia. Sodium hydrogen carbonate ($NaHCO_3$) for analysis was purchased from Merck, Germany. Freeze-dried Cheese starter culture FD-DVS.R707 consisting of *Lactococcus lactis* ssp. *cremoris* and *Lactococcus lactis* ssp. *lactis* and enzyme for soft cheese making (CHY-MAX®PLUS; the active milk-coagulating enzyme is chymosin EC3.4.23.4) were obtained from Chrystian Hansen Laboratory Denmark. The soft cheese production was done using saga bean milk prepared following the method of Amar, Makosim, Anggraeni *et al*. (2021). Five formulae of saga milk, consisting of saga milk (SM) and cow milk (CM) of different ratio were formulated as follows: F3 = (80% SM:20%CM); F4 = (70%SM:30%CM); F5 = (60% SM:40%CM); F6 = (50%SM:50%CM); and F7 = (40% SM:60%CM). In total, 1,500 mL of each formula was prepared, pasteurized for 2 mins at 72-75°C, and then cooled at 32°C. Subsequently, 450 mL of each formula was inoculated with 0.0185% freeze-dried cheese culture and stored at 32°C for 24 hrs and later used as a starter for making saga soft cheese. This starter was then inoculated into the 1,050 mL saga milk formula at 32°C. At the same time, 0.02% renin enzyme was added (v/v). Curd formation was observed every 30 mins. The formed curd was stirred and then filtered using nylon cloth until all the curd was recovered. These experiments were performed in quadruplets. All data obtained (chemical analysis, and texture properties) were statistically analysed using analysis of variance and Duncan's new multiple range test at the level of 5%.

2.1 Chemical analysis

Chemical analysis included the determination of the total suspended solid and fat content of the formula according to Food Safety and Standards Authority of India (2015). The fat content was analysed using the Mojonnier-alkaline method, with ammonia as the solvent. The method was performed thrice to obtain an oil extract that was purer than the sample. Protein content was determined following the Lawry-Follin method (Santosa *et al*., 2019).

2.2 Rennet clotting time

Rennet clotting time was measured using the

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method of Metwalli *et al*. (1982) with some modifications. In total, 1,500 mL formulated milk in a glass beaker, in which cheese culture was inoculated before, was clotted at 32±0.5ºC with 0.02% enzyme and left standing until changes were visible. Clotting time was determined by recording the time of enzyme addition and the appearance of early solidification, indicative of curd formation. The yield analysis was calculated based on the ratio between the weight of the cheese obtained and the weight of the milk used multiplied by 100% (Wiedyantara *et al*., 2017).

2.3 Texture analysis and sensory evaluation

The texture properties of SSC products were determined using Texture Analyzer TAXT (Stable Micro Systems Ltd Surrey, UK) using a back-extrusion yogurt profile. The penetration of the cylindrical probe, 1 cm in diameter, into the soft cheese sample was assessed. A glass container was used. All measurements were performed as soon as the sample was removed from the cooling room at 15±1°C. The probe speed at the time of the test was set to 1 mm/s, and the trigger force was 0.01 N and it entered the sample to a depth of 10 mm. After the probe reached the maximum depth, it was moved out of the sample so that the response of the sample would be read through the graph formed. Samples of SSC that had been prepared were attached to the moving crosshead and were associated with the program analysis. Six parameters could be obtained from this measurement as shown in Table 3.

2.4 Sensory evaluation

The acceptability of five SSC formulae was tested. The panellists were 40 semi-trained panellists individuals aged 18-60 years. Samples were presented after adding 1.5% salt. In this sensory test, the panellists were asked to respond to the degree of preference for the colour (appearance), texture, aroma and taste of SSC samples. The hedonic scale was converted into a numerical scale, with the number increasing by favourite level. The sensory test results were graded as follows: 9 = extremely like, 8 = like very much, 7 = Like, 6 = slightly like, 5 = neutral, 4 = slightly dislike, 3 = dislikes,2 = really do not like, 1 = extremely dislike. According to Fliedner and Wilhelmi (1993), grades 1-4 were present in a group that was not preferred, while grades 6-9 were in the preferred group. A score of 5 is characteristic of a group that does not desire improvement in the quality of new products. At least 80% of panellists provided ratings between 6-9, indicating that the product is the most preferred. The reception of the sensory attributes is shown below: a) 94%-100% indicates exceptionally accepted (free from complaints, no improvement necessary); b) 87%-93% indicates more than accepted (almost free of complaints, no improvement necessary); c) 80%-86% indicates (not free of complaints, require improvements one of sensory parameters); d) 73%-79% indicates almost accepted (complaints made, required more improvements on one or two sensory parameters); e) 66%-72% indicates far from accepted or barely accepted (serious complaints made, required more improvements on some sensory parameters); 0%-65% indicates not accepted as a new product. The texture of the cheese was characterized by four attributes, namely, granularity, creamy, softness, (texture by mouth) and texture by hand such as spreadability or stickiness (Jeon *et al*., 2012).

3. Results and discussion

3.1 Chemical composition of raw saga milk formula

The chemical compositions of the different types of saga milk formula used in this study are presented in Table 1. The decrease in saga milk content in the saga milk formula increased the chemical composition of total solids, total protein, ash, and viscosity of all SSC samples; these increases were only significant ($p \leq 0.05$) in the Saga Milk Formula F5, F6 and F7. In contrast, the fat content decreased in all saga milk formulas. There was no significant reduction of fat content in any saga formula except in Formula F7 ($p \leq 0.05$). The reduction in saga milk content reduced the pH of the formula significantly ($p < 0.05$), although a reduction by up to 60% had no effect when compared to a reduction of up to 30% or 50% reduction. This was because the Calcium content of saga milk is relatively higher than that of cow milk. However, the reduction in saga milk content in the formula tended to lower the pH, this was due to the calcium content of saga seed, which was up to 1062 mg/100 g (Kementerian Kesehatan RI, 2018) as opposed to only 119.6 mg/100 g in cow milk (Rodriguéz *et al*., 2001). Calcium ions are metal ions that can react with residual acid ions, therefore the H^+ ions in the solution will be replaced by metal ions resulting in an increase in pH.

The decrease in saga milk content in the saga formula increased the total solids content, which was because the total solid content in cow's milk was considerably more than that in saga milk. The average total solid of cow's milk is 11.73% (Saputra, 2018), while that in saga milk is 8.66 - 9.3%. Saga milk formula with a higher concentration of saga milk had a lower viscosity than that with a lower concentration of saga milk. The percentage of the total solid /dry weight and percentage of fat appeared to affect the viscosity of the saga milk formula. However, the content of phospholipid compounds presented in cow's milk caused the fat in saga milk formula to be dispersed; formula with more

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Table 1. Chemical composition of milk as raw material for saga soft cheese.

Saga Milk Formula (%)	pH (%)	Total solids (%)	Fat (%)	Total Protein (%)	Ash (%)	Viscosity (cP)
F3	7.42±0.3[a]	11.32±0.28[b]	3.87±0.02[a]	2.82±0.51[c]	0.71±0.02[b]	15.23±0.4[c]
F4	7.19±0.2[a]	11.47±0.09[b]	3.86±0.18[a]	2.99±0.43[bc]	0.78±0.05[b]	16.00±1.23[c]
F5	6.93±0.4[ab]	11.61±0.21[ab]	3.84±0.32[a]	3.12±0.46[b]	0.84±0.07[a]	18.11±0.93[b]
F6	6.86±0.3[b]	11.79±0.17[a]	3.82±0.29[a]	3.23±0.32[b]	0.86±0.12[a]	22.00±1.21[a]
F7	6.82±0.2[b]	12.01±0.22[a]	3.76±0.41[b]	3.76±0.31[a]	0.91±0.08[a]	23.21±0.51[a]

Values are presented mean±SD, n = 4. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

cow's milk dispersed more than formula containing less cow's milk. The good, emulsifying properties of phospholipids could be used for the delivery of lipo-soluble constituents (Contarini and Povolo, 2013).

The yield of soft cheese depended on the content of individual chemical components or on more than three components of milk (Zeng *et al*., 2007). The total solids and curd protein content and fat content in goat milk considerably affect the yield of soft cheese. Factors affecting the formation of cheese curd included milk components, protein in particular, casein, the quality of milk, and the type of coagulating agent (Zeng *et al*., 2007). Sanches-Muhnoz *et al*. (2017) reported that several factors including different types of substrates and enzyme concentrations, affected milk clotting activity. Therefore, the composition of the substrate in the saga milk formula was important for the clotting of cheese. Reducing saga milk content in the saga milk formula increased the protein content, but decreased the fat content.

Research on soy-based cheese or non-dairy milk alternatives has been widely reported; for example, Gouda cheese analog based on soy protein isolate (Amar and Surono, 2012) and non-dairy milk alternative based on soymilk and almond milk (Kundu *et al*., 2018) are available. Amar and Surono (2012), reported that soy-based gouda cheese analog differed from that of SSC. Gouda cheese was manufactured using the heating method to produce gel, followed by fermentation, while the saga fresh cheese was manufactured using the conventional cheese manufacturing method. The addition of cow's milk in saga milk formula during SSC manufacture increased the yield. This can be because the high protein content of cow's milk in saga milk formula promoted curd formation. As shown in Table 2, reducing saga milk content in saga milk formula can increase the yield of SSC.

3.2 The effect of saga milk formula on the clotting time, yield and property of curd

Decreasing the concentration of saga milk in the saga milk formula accelerated the curd formation time, as the saga milk formula affected the clotting time of milk. The less the amount of saga milk in the formula, the faster the clotting time ($p<0.05$). This might be due to the presence of saga milk in the formula inhibiting the digestion of peptides in cow's milk in the formula by adsorbing casein, the substrate of renin, thereby interfering with the optimal curd formation. Lee and Marshal (1984), suggested that as much as 20% of soy protein in milk formula may be trapped in the casein micelles formed or bound to casein micelles. In our study, the more the amount of saga in saga milk formula, the longer the process of curd formation, hence we assumed that saga protein covered the area of casein that is targeted by enzymes. As a result, curd formation was prolonged

The reduction of saga milk content in the saga milk formula significantly increased SSC yield ($p<0.05$). The yield with F3 to F5 was small because a large amount of saga protein was trapped in the matrix of casein micelle which was not strongly adsorbed and dissolved in the whey during filtration. The more saga milk in the saga milk formula the more turbid was the whey. Li *et al*. (2018) reported that soy protein was hydrophilic and was able to bind water molecules because of hydrogen bonds. which might be true even for saga seed protein. The process of curd formation in saga soft cheese was identical to that observed before filtration; although the yield was high, it decreased after filtration and pressing, as the saga protein dissolved in the whey. The yields were highest with F6 and F7 Formulae, reaching 21.36% and 20.87% respectively, and did not differ significantly with the formulae ($p<0.05$). This was still higher than that reported by Arlene *et al*. (2015), regarding the yield of Cheddar cheese (10.99%) manufactured from cow's milk, but was lower than that reported by Ayodeji *et al*. (2020), for cheese made from soy milk and cow's milk, the yields of which reached 25% and 26%, respectively. In this study, all the proteins and fats in saga milk had been perfectly trapped or tightly bound to the surface of the casein micelle, which would have increased the yield. The liquid in the whey was clear, and the texture of SSC was soft to firm.

Table 2 clearly shows that reducing the concentration of saga milk in saga milk formula rendered

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Table 2. Effect of the saga milk formula on clotting time, property of curd, and the yield of saga soft cheese

Saga Milk Formula (%)	Rennet clotting Time (min)	The appearance body of curd	Yield (%)
F3	360.00±3.24[a]	soft agglomerate cloudy	6.68±1.41[c]
F4	300.50±2.06[a]	soft aggregate slightly cloudy	8.20±2.24[c]
F5	288.50±7.22[a]	soft rather clear	15.55±0.95[b]
F6	67.00±2.12[b]	soft clear	21.31±3.88[a]
F7	61.75±1.48[b]	soft-firm very clear	20.87±2.64[a]

Values are presented mean±SD, n = 4. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

the whey produced during the manufacture of SSC clear. In particular, there was a balance between saga protein and casein in the F6 formula (50% SM: 50% CM); the obtained became clear as more saga protein could not dissolve in the whey. The more the amount of saga protein in the saga milk formula, the cloudier the whey produced after curd formation. This result indicate that a large amount of the saga protein dissolved in the whey did not bind to the surface of the casein micelles. The decrease in the concentration of saga milk in the saga milk formula increased the yield significantly ($p <0.05$).

The lower the concentration of the saga milk in the saga milk formula, the firmer the texture of the curd formed. This indicated that the saga milk protein trapped in the net or bound to the casein micelle surface did not interfere with curd formation. The higher the concentration of saga milk in the saga milk formula, the softer and more brittle the curd, as strong bounds were lacking. Therefore, filtering was challenging, and as a result, the whey was very turbid. This indicated the presence of many dissolved solids (saga milk protein and also fat) in the whey that was not trapped in the net or was not attached to the surface of the casein micelles. Based on the yields obtained, F6 and F7 were the most appropriate Formulae, and the curd was compact and not brittle.

3.3 Effect of saga milk formula on the texture of SSC and its spreadability

Table 3 shows that reducing the concentration of saga milk in saga milk formula significantly increases the hardness of SSC ($p<0.05$) and its cohesiveness. However, in F7 Formula, hardness and cohesiveness again decreased and differed significantly ($p <0.05$) from F6 formula. Hardness indicates the texture strength of SSC, which should not be too high, as only a compact structure with a soft texture is desired. SSC is not hard or semi-solid cheese, but a soft cheese like product that can be easily spread on the surface of the bread. In this study, F6 Formula of SSC resulted in the highest hardness, reaching 49.58 gf, which was still lower than the observed by Jeon *et al*. (2012). Reports show that the hardness of cream cheese made from whole milk reached 58.12 gf. The hardness of SSC differed considerably from that of soy milk-based cheddar cheese, which was 100.1 gf (Arlene *et al*., 2015). The SSC hardness obtained using the F6 formula is sufficient for it to be applied on the surface of the bread. Cohesiveness indicates the strength of the internal bonds between molecules in cheese. Therefore, the greater the cohesiveness of cheese, the harder the bond to the surface of another object. This is not desirable in soft cheese like products.

Gumminess can be obtained by multiplying hardness and cohesiveness; thus, the value of its value is in agreement with those of hardness and cohesiveness. As shown in Table 3, reducing the concentration of saga milk in saga milk formula significantly increased the gumminess of SSC ($p<0.05$). However, when the F7 formula was used, the gumminess decreased significantly ($p<0.05$). Gumminess should not be too high, because the texture of SCC must be soft and easy to spread on the surface of bread. The gumminess of cream cheese made from whole milk (Jeon *et al*., 2012), reached 45.88 gf, which was slightly higher than the gumminess of SSC in this study (44.80 gf). This showed

Table 3. Effect of saga milk formula on texture property of saga soft cheese.

Saga Milk Formula (%)	Hardness (gf)	Cohesiveness	Gumminess (gf)	Springiness	Chewiness (gf).mm	Spreadability
F3	19.68±2.12[c]	0.43±0.02[c]	8.47±0.1[d]	0.51±0.01[d]	4.23±1.5[c]	Easily applied, not sticky
F4	25.06±1.56[b]	0.55±0.01[c]	13.70±0.4[c]	0.48±0.02[d]	6.23±2.0[c]	Easily applied, not sticky
F5	30.00±2.24[b]	0.74±0.02[b]	22.11±0.2[b]	0.57±0.01[c]	12.13±2.3[b]	Easily applied, not sticky
F6	49.58±3.23[a]	0.91±0.05[a]	44.80±0.9[a]	0.71±0.04[b]	29.92±1.2[a]	Easily applied, rather sticky
F7	29.00±2.09[b]	0.68±0.01[b]	20.26±1.2[b]	0.91±0.02[a]	19.21±1.9[b]	Easily applied, rather sticky

Values are presented mean±SD, n = 4. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

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that the gumminess of SSC was almost similar to that of cream cheese made from whole cow milk. However, when the F7 formula was used the gumminess decreased again and differed significantly from that obtained using the F6 formula. This indicated that all saga protein was trapped in the casein micelle matrix, which was abundantly formed and provided a soft sensation.

Springiness indicates the elasticity of the product; the higher the springiness value, the more elastic is the product. Based on texture profile analysis, springiness is defined as the height that the food recovers during the time that elapsed between the end of the first bite and the start of the second bite. Less springiness of SSC was required in order to spread it on the surface of the bread. SSC is expected to stick firmly on the bread surface. Table 3 shows reducing the concentration of saga milk in saga milk formula significantly increased the springiness of SSC ($p<0.05$). The lower the concentration of saga milk in the saga milk formula, the higher the springiness. We assumed that the matrix formed by casein micelles was getting stronger because it was not attached by excessive hydrophilic saga milk protein trapped in the net, which increased the elasticity of the product. The springiness of cheese made using the F6 Formula reached 0.71±0.04 mm, which was significantly lower than that obtained using Formula F7 (0.91±0.02mm). Jeon *et al*. (2012), showed that the springiness of fresh cream cheese made from cow's milk was 26 times that of cheese made using F7.

Reducing the concentration of saga milk in the saga milk formula significantly increased the value of chewiness ($p<0.05$). The highest chewiness value was obtained in F6 formula. Chewiness describes the energy required to masticate a solid food product to a state ready for swallowing. It is related to the primary parameter of hardness, cohesiveness, and springiness, or a product of gumminess multiplied by springiness. All products could be smeared well on the surface of bread; however, the ones made F6 and F7 formulae stuck well.

3.4 Effect of saga milk formula on the sensory property of the product

Products manufactured using F5, F6 and F7 Formulae are generally accepted but belong to different categories. F6 and F7 were in the same category, which was acceptable and almost free of complaints, with no need for improvement of the sensory properties. There were a few complaints about the F5 product and one sensory parameter required improvement. Table 4 shows that the sensory values for the colour in all products ranged from slightly accepted (acceptance panelists = 72) to exceptionally accepted (acceptance panelists = 100). In contrast, the aroma and taste none of the formulae were acceptable. The aroma and taste of cheese obtained using formulae 3 and 4 were not accepted by the panellists due to strong beany flavour, and the taste was not similar to that of cheese in general. The reduction in the concentration of saga milk in the saga milk formula resulted in a taste and aroma that were favoured by panellists. This was because of the general taste of cheese, which could cover the unpleasant beany flavour of saga milk.

The texture component consisted of granularity, creaminess and softness parameters, which is known as the texture by mouth feel (Jeon *et al*., 2012). Interestingly, reduction in the concentration of saga milk in saga milk formula increased the granularity of the product. We believe that the saga milk protein inhibited the formation of a smooth and compact curd in SSC. Lie *et al*. (2018), reported that soymilk inhibited the aggregation of skim milk, which increased moisture content and curd yield significantly, and the resulting network was coarse. In our study, SSC with low granularity was obtained in terms of texture by mouth, which indicated that SSC texture felt at the tip of the tongue was coarse, similar to that of fine sand. This condition was not favored by all panellists, the panellists who wanted SSC texture to be soft and creamy.

For creamy and softness parameters, the lower the concentration of saga milk in the saga milk formula the less creamy and softer the product. This was assumed to be because of the high-fat content in the formula and the hydrophilic property of saga milk protein. Fat and saga milk protein, together with phospholipid of cow milk, bound water molecules to form a creamy product and increased the softness. However, in general, only SSC with F6 and F7 formulae were sensory acceptable to be developed into SSC products. SSC products can be

Table 4. Acceptance percentage of saga soft cheese.

Formula	Colour	Texture				Flavour	Taste	Overall Acceptability	Average Acceptance
		Granularity	Creamy	Softness	Average				
F3	72	65	90	97.5	84.2	55	42.5	NA	
F4	75	77.5	87.5	90	85	65	60	NA	
F5	90	77.5	85	82	81.5	80	80	331.5	82.9
F6	100	82	81	80	81	82.5	87.5	351	87.8
F7	92.5	92.5	80	78	83.5	87.5	85	348.5	87.1

NA: Not Accepted.

developed further, it has passed the sensory test of the panellists. The raw material for this product is 50% saga milk. Previously, Amar, Makosim, Nurani *et al*. (2021) have shown that saga milk predominantly contains essential fatty acids, including oleic acid, linoleic acid, and lignoseric acids. Therefore, further research on SSC is required to confirm its nutritive value.

4. Conclusion

Saga soft cheese can be produced by mixing saga milk with cow's milk using the rennet enzyme and lactic acid bacteria culture which is commonly used for conventional cheese. The lesser the concentration of saga milk in saga milk formula, the closer the aroma and taste of SSC were to cheese in general. The 50:50 or 40:60 ratio of saga milk and cow's milk was optimal for obtaining a high yield of SSC; the curd appeared compact and soft. All sensory attributes, including appearance, texture by mouth (granularity, creamy and softness), texture by hand (spreadability), aroma and taste were accepted and were suggested for obtaining a high yield of SSC with sensory properties endorsed by the panelists. Because the raw material contains saga milk, which has long chain saturated fatty acids that process a lipid-lowering effect SSC products made from 50% saga milk:50% cow milk may be further developed.

Conflict of interest

The authors declare no conflict of interest.

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