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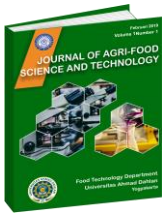

Production of Coconut Milk Cheese and Its Organoleptic Characteristics

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ABSTRACT

Cheese is a dairy product that contains lactose so it cannot be consumed by lactose intolerant. Coconut milk can be used as an alternative to produce lactose-free cheese. This study contribution to investigate the effect of coconut milk and soy milk composition on the physical and chemical properties of coconut milk cheese, as well as product acceptability. Direct acidification using lemon juice is used to produce cheese with different coconut milk and soy milk composition (80:20; 70:30; 60:40). The properties assayed were yield, spreadability, and organoleptic. Yield of coconut milk cheese at composition 80:20; 70:30; 60:40 was 37.96%; 34.44%; 31.48%. Spreadability of coconut milk cheese at composition 80:20; 70:30; 60:40 was 9.83 cm; 9.65 cm; 9.53 cm. The difference of coconut milk and soy milk composition affects the physical and organoleptic properties of coconut milk cheese. Decrease in the level of coconut milk substitution and increase in the level of soy milk substitution led to decrease yield and cheese spreadability. Organoleptic score below 3 indicates that coconut milk cheese acceptability was still low.

1. INTRODUCTION

Cheese is one of the dairy products that is widely consumed by the public. GEA (Global Engineering Alliance) data shows that Asia was the region with the largest cheese market growth in 2016 (CAGR 5.3%). Cheese cannot be consumed by people with lactose intolerance (LI) because it contains lactose which is the main carbohydrate in cow's milk (Gambelli, 2017). LI refers to the condition of a person's inability to digest lactose caused by decreased activity or lack of lactase causing digestive symptoms such as bloating,

diarrhea, and excessive gas production (Deng, et al., 2015). Lactose intolerance (LI) is one of the most common health problems in the Asian region. A study in Indonesia showed the prevalence of LI in children aged 3-5 years; 6-11 years; and 12-14 years respectively, namely 21.3%; 57.8%; and 73% (Hegar & Widodo, 2015). The lactose content in 100 grams of cheese ranges from 0.35-7.05% (USDA, 2012).

Several studies have tried to develop low/lactose-free cheese products made from soy milk (non-dairy) for LI sufferers (Kurniawan, Wulan, & Pranata, 2007). Research by Lorrungruang, et al. (2014) developed red cheese from soy milk by utilizing specific microorganisms, namely *L. casei* and *M. purpureus*. Sensory results showed that the texture and colour of red soy cheese was not different from that of cow's milk red cheese. Meanwhile, in terms of taste and aroma, panellists preferred red soy cheese than cow's milk red cheese because of the intense (stinging) nutty smell.

Another ingredient that can be used as an alternative to cow's milk in the manufacture of low/lactose-free cheese is coconut milk. Coconut milk is an ingredient that is widely used in the development of milk-based alternative products (Amarasiri & Dissanayake, 2006). The protein content in coconut milk is almost the same as in milk (3.2%) which is about 3.33% (Sangamithra, et al., 2013). The protein contained in coconut milk allows the coagulation of proteins needed in cheese making (Nugusu & Gudisa, 2016). According to previous research, making cheese from coconut milk alone is not possible because the protein characteristics of coconut milk and cow's milk are different so that coagulation using rennet does not occur (Tipvarakarnkoon, 2009). The use of coconut milk in the manufacture of non-dairy cheese must be combined with soy milk to help the coagulation process. Coconut milk contains about 33% fat which has a savoury flavour so that it can enrich the taste of cheese while covering the pungent aroma of soybeans which are less preferred (Sangamithra, et al., 2013).

The use of coconut milk as a raw material for making cheese can reduce the number of imports of soybeans. The volume of soybean imports in 2015 was relatively high, reaching 6.42 million tons (fulfilling 86.95% of domestic soybean needs). Meanwhile, coconut (an ingredient for coconut milk) is a commodity that has high productivity in Indonesia, which reached 2.87 million tons in 2017 (Anonim, 2017). This paper contribution to analyze the effect of coconut milk and soy milk formulations on the physical and organoleptic characteristics of coconut milk cheese.

2. MATERIALS AND METHODS

2.1. Materials

The equipment used in the product manufacture is a stainlesssteel pan, thermometer, pH meter, spatula, filter cloth, knife, filter, bowl, stove. While the ingredients used are coconut milk (merck: Kara), soy milk purchased at the market, lemon juice (local lemon fruit), and salt (merck: Dolphin). The equipment used in determination the characteristics of coconut milk cheese are knife, ruler. While the materials used are bread and aluminium foil.

2.2. Research Methods

2.2.1. Coconut milk cheese production

Production of coconut milk cheese can be seen ini Figure 1. Coconut milk and soy milk were used as raw materials. Both of them was mixed and boiled (80 ^{o}C; 10 min). Extract lemon was added before the boiling process. Next, the mixture was cooled at room temperature (30 min). The curd and whey was separated. The curd was drying ± for 7 hrs in room temperature. Then, the coconut milk cheese was packaged.

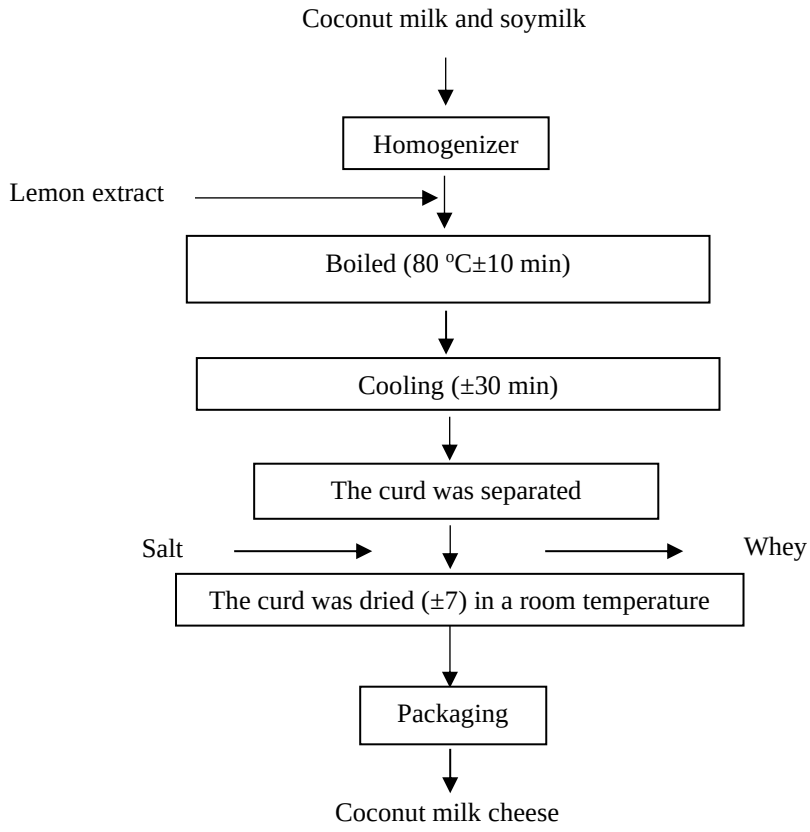

Figure 1. Coconut milk cheese production

2.2.2. Formulation

The formulation of the composition of cheese making ingredients consists of 3 kinds where the ratio of coconut milk and soy milk is 80:20; 70:30; and 60:40. The formulation of the composition was determined based on previous research which made cheese with the composition of coconut milk and cow's milk, namely 50:50 (Tipvvarakarnkoon, 2009). In this study, cheese was not made with 100% and 90% coconut milk formulations because the manufacture of cheese with these compositions was not successfully made in Soler's (2005) study.

2.2.3. Spreadability

Spreadability is one of the important texture aspects for soft cheese products. Good soft cheese products must be able to be spread at room temperature or when cold (Phadungath, 2005). Testing the spreadability of coconut milk cheese based on the method of Yuwono & Susanto (1998) with modifications.

2.2.4. Yield

Cheese yield is defined as the amount of cheese obtained from the milk used. Measurement of coconut milk cheese yield based on the research method of Igyor, Igbian, & Iorbo (2006) with the following equation:

$$Yield\ (\%) = \frac{weight\ of\ cheese\ curd\ (g)}{Total\ weight\ of\ raw\ materials\ (g)}\ x100\%$$

2.2.5. Organoleptic characteristics

Testing of the organoleptic properties of coconut milk cheese which includes color, aroma, texture and taste was carried out using a sensory test to 30 untrained panelists (SNI, 2006) with 5 scales, 1: Very dislike, 2: Unlike, 3: Rather like, 4: Like, 5: Very like (Fitriani et al., 2021b).

2.2.6. Data analysis

The data from the observation of each ingredient formulation treatment were analyzed descriptively by comparing the literature and previous studies.

3. RESULT AND DISCUSSION

3.1. Coconut milk cheese production

The cheese in this study is made from a mixture of coconut milk (SUN KARA) and soy milk (from traditional markets) with the composition according to the research design. Meanwhile, the nutritional content of SUN KARA coconut milk used in this study is listed in Table 1.

Table 1. Nutrition value of commercial coconut milk "SUN KARA" per 100 ml

Parameters	Quantity
Energy	245 kcal
Total lipid	24 g
Total carbohydrate	2.1 g
Protein	2.6 g
Sodium	16.4 mg
Potassium	219 mg

Source: PT. Karacoco Nucifera Pratama

Cheese making in this research is based on protein clumping and fat trapping in the formed protein matrix. The coagulation process carried out consists of 2 types, namely coagulation using acid and heat. In this study, lemon juice was added until the pH of the solution (coconut milk and soy milk) reached 4.6. Determination of the pH of cheese making is based on the literature on the isoelectric point of protein in coconut milk and soy milk, as well as the results of pre-trial cheese making. pH 4.6 was used because coagulation could be achieved at that pH and produced cheese that was acceptable to the panelists. Meanwhile, at a pH below 4.6, it will form cheese with a very strong sour taste (hard to be accepted by the panelists' tongue). The addition of lemon juice in cheese making will lower the pH to near the isoelectric point of the protein in coconut milk and soy milk. Research by Raghavendra & Raghavarao (2010) showed that coconut milk protein can be easily coagulated at pH 4, which is a value close to the isoelectric point of coconut milk protein, which is pH 3.5-4. While the isoelectric point of soy milk protein is around pH 4.5-5 (Kempka et al., 2014; Li, 2005). When approaching the protein isoelectric point, the electrostatic repulsion between the particles decreases due to the loss of surface charge, allowing protein particles to be close together, interact, and aggregate through hydrophobic interactions to form aggregates (Tangsuphoom, 2008; Ringgenberg, 2011). The protein network formed can trap water, fat, carbohydrates, and other components contained in soy milk and coconut milk (Ringgenberg, 2011).

The heating process also affects protein coagulation in coconut milk and soy milk. Heating causes hydrolysis of large molecular proteins in the food into

smaller molecules as peptides or amino acids (Fitriani et al., 2021a), it also lead the opening of the protein structure thereby exposing functional groups previously enclosed in the structure (hydrophobic areas) and allowing protein-protein and protein-water interactions. The balance between these interactions will determine the three-dimensional network that forms the protein gel (Benassi, Yamashita, & Prudencio, 2011; Tang, et al., 2005). In this study, the coagulation temperature used in cheese making is 80^0C. Research by Widjajaseputra & Widyastuti (2017) shows that coconut milk protein coagulates when heated at a temperature of 80.9^0C. The coagulated coconut milk protein molecules will gather to form a regular protein network (Rhee, 1995). Research by Benassi, Yamashita, & Prudencio (2011) showed that the appropriate coagulation temperature for soy milk protein was 75^0C.

3.2. Yield

Yield is very important in determining the economic value of cheese because a slight difference in yield results in a large difference in profit (El-Gawad & Ahmed, 2011). The average yield of coconut milk cheese with the ratio of coconut milk and soymilk composition is shown in Table 2. The results show a downward trend in yield along with a decrease in the composition of coconut milk and an increase in the composition of soy milk.

Table 2. Yield of coconut milk cheese

Coconut milk and soy milk ratio	Yield (%)	FPC value (%)
80:20	37.96	32.15
70:30	34.44	32.23
60:40	31.48	31.47

Cheese yield is influenced by several factors such as FPC (Fat+Protein Content) value and moisture content. The FPC value and cheese yield have a directly proportional relationship where the higher the FPC value, the higher the cheese yield (Verdier-Metz, Coulon, & Pradel, 2001). Moisture content also has a major influence on cheese yield. The results show that increasing the water content fraction from 0.32 to 0.37 can increase the yield by 0.15% (El-Gawad & Ahmed, 2011). The results show that the FPC value of cheese with a composition of 80:20 is not much different from a composition of 70:30, but differs from a composition of 60:40.

Based on the relationship between the FPC value of cheese and yield which is directly proportional, cheese with a composition of 70:30 will have the highest yield, followed by a composition of 80:20 and 60:40. However, the yield obtained in this study is not directly proportional to the FPC value. This is because the yield of cheese is also influenced by the moisture content of coconut milk cheese (respectively from the 80:20 composition of 64.93%; 61.92%; and 60.49%). The FPC value of coconut milk cheese composition 80:20 and 70:30 did not differ much, but the moisture content of coconut milk cheese composition 80:20 was higher than the composition 70:30 so that the yield of coconut milk cheese composition 80:20 was also higher.

3.3. Spreadability of Coconut Milk Cheese

The spreadability referred to in this study is how far the distance of the oil is obtained without any fractures. The average greasing power of coconut milk cheese with the ratio of coconut milk and soy milk composition is shown in Table 3. The results show that the greasing power of coconut milk cheese in each composition is

significantly different. The greasing power of coconut milk cheese decreases along with the decrease in the composition of coconut milk and the increase in the composition of the soy milk used.

Table 3. Spreadability of coconut milk cheese

Coconut milk and soy milk ratio	Spreadability (cm)
80:20	9.83
70:30	9.65
60:40	9.53

The type of coconut milk cheese in this study included soft cheese (moisture on a fat-free basis > 67%) based on the CODEX classification. The important texture characteristics of soft cheese are smooth without lumps or cracks, and have good greasing power (the right consistency so that when applied it does not flow and does not produce fractures) (Phadungath, 2005). Most cheese products are viscoelastic (Tariq, Giacomin & Gunasekaran, 1998). The water content plays a role in reducing the viscosity of the cheese, and the fat content acts as a lubricant or lubricant in the cheese. Both factors contribute to improving the more fluid behavior of cheese. On the other hand, protein content plays a role in strengthening the strength of the dimensional matrix of cheese so that it further increases the behavior of a denser cheese (Attalla, et al., 2014).

Based on table 3, the spreadability of coconut milk cheese decreases with the increase in the composition of soy milk and the decrease in the composition of coconut milk. Changes in the composition of soy milk and coconut milk affect the FPC value, where an increase in the composition of soy milk and a decrease in the composition of coconut milk results in an increase in FPC value. The decrease in the spreadability of the cheese in this study was in accordance with the literature, where the higher the protein content of the cheese, the denser the cheese which was difficult to spread. The decrease in the spreadability of cheese is also due to the lower fat content and moisture content of the cheese which acts as a lubricant or lubricant, resulting in cheese that is drier, brittle, and difficult to spread.

3.4.Organoleptic characteristics of Coconut Milk Cheese

The results of organoleptic assessment in color, aroma, texture, and taste of each coconut milk cheese formulation are shown in Figure 2. The organoleptic test in this study was a hedonic test (liking) with a scale of 1-4 (1 = very dislike; 4 = very like), which means the higher the score obtained, the more preferred the product by the panelists. Figure 2 shows the color and aroma that the panelists most favored, namely 80:20 formulation cheese, while the panelists' most preferred texture was 60:40 formulation cheese, and the panelists' favorite flavor was 70:30 cheese formulation. The score of organoleptic results of coconut milk cheese has not yet reached a score of 3, which means that coconut milk cheese products are still not favored by the panelists.

The color of coconut milk cheese that the panelists liked the most was the cheese with the most coconut milk composition and the least soy milk composition. This could be due to the panelists preferring white cheese compared to yellowish white. Coconut milk is thick white in color (Hartayanie, Adriani, & Lindayani, 2014), while soy milk is yellowish white. The yellowish white color in soy milk comes from the yellow riboflavin content (Suryana, 2013). Panelists' preference for whiter colors can be related to the perspective of panelists who compare cheese from cow's milk which is generally

white.

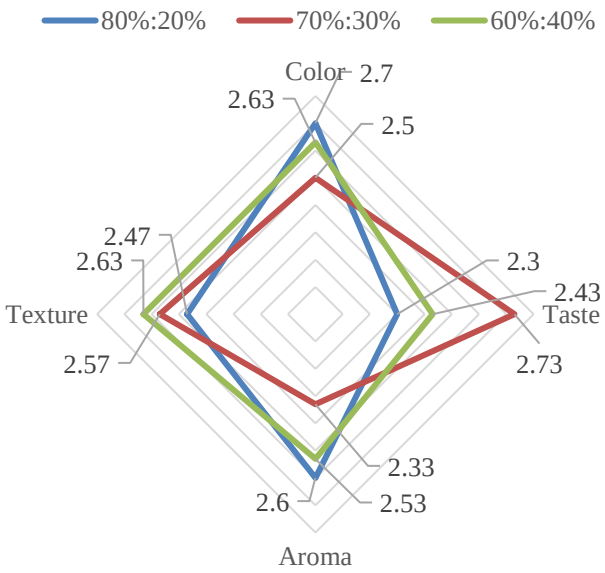

Figure 2. Organoleptic characteristics of coconut milk cheese

The aroma of coconut milk cheese that the panelists liked the most was also the cheese with the highest composition of coconut milk and the least composition of soy milk. This can be caused by the panelists preferring the distinctive aroma of fragrant coconut milk compared to the aroma of soy milk which tends to be unpleasant. The volatile components in coconut milk (delta-C8-lactone, delta-C10-lactone, and n-octanol) give the characteristic aroma of coconut milk which is strong, distinctive and dominant (Prabawani, 2011). One of the drawbacks of soy milk is the unpleasant aroma that comes from the oxidation of unsaturated fatty acids in soybean seeds (especially linoleate) by the lipoxygenase enzyme (Ginting & Antarlina, 2002).

The texture of the coconut milk cheese that the panelists very like was the cheese with the lowest coconut milk composition and the highest soy milk composition. This can be caused by the panelists prefer cheese with a compact and dense texture. Cheese with a higher composition of soy milk has a higher protein content (the protein content of soy milk is 6.73%, while the protein content of coconut milk is 2.6%). This protein content plays a role in strengthening the dimensional matrix of the cheese so as to produce a more compact and dense cheese (Attalla, et al., 2014). The texture of coconut milk cheese is very soft (soft-cheese), in contrast to the texture of cheese made from cow's milk (can form hard-cheese). The difference in texture is due to the different protein characteristics of coconut milk and cow's milk. Cow's milk protein, casein, forms micelles along with calcium phosphate. Coagulation with acid will cause calcium phosphate to be unstable and form calcium ions which help the process of protein aggregation (formation of protein networks) (Lucey & Fox, 1993). Cheese with higher calcium content will produce a denser cheese (McMahon, Paulson, & Oberg, 2005). The absence of calcium phosphate in coconut milk protein can be the cause of differences in the texture of coconut milk cheese and cow's milk cheese.

The taste of coconut milk cheese that the panelists most like was cheese with a composition of coconut milk: soy milk at 70:30. The panelists' preference can be caused by the panelists not liking the taste of coconut milk which is too savory or the unpleasant taste of soy milk. Cheese composition 80:20 may have a coconut milk taste that is too strong and savory (contribution to the fat content of coconut milk is quite high) (Sangamithra, et al., 2013). Meanwhile, cheese with a composition of 60:40 may have

a distinctive soy taste that is too sweet so that the panelists do not like it. The unpleasant taste of soy milk also comes from the activity of the lipoxygenase enzyme which oxidizes fat in soybean seeds (Ginting & Antarlina, 2002). Thus, the cheese composition 70:30 is probably the panelists' most favorite because the savory taste of coconut milk is not too intense, but can cover the unpleasant taste of soy milk.

4. CONCLUSIONS

The formulation of ingredients for making coconut milk cheese affects the physical and organoleptic characteristics of coconut milk cheese. As the composition of coconut milk is reduced and the composition of soy milk is added, the yield and the cheese spreadability decreases. All of the organoleptic parameters did not show a high score, indicating that the coconut milk product is still not favored by the panelists. The most preferred coconut milk cheese by panelists in color and aroma is cheese composition 80:20, texture profile is cheese composition 60:40, and taste is cheese composition 70:30.

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