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A Preliminary Study of Cheese With Different Pasteurization Methods

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Abstract

Cheese, a product derived from cow milk by combining both heating and coagulating milku sing rennin enzyme. The proper heating of milk produces cheese with good quality. The study conducted to investigate the different methods of pasteurization on the yield and total solid of cheese. Reaearch designed by Completely Randomized Design (CRD) with 4 treatments and 5 repetitions. Pasteurization applied was low temperature long time (LTLT) with 63°C, treatments were different time of pasteurization, there were P1: 30, P2: 40, P3: 50, and P4: 60 minutes. Data was analyzed using analysis of variance and post-hoc Duncan Multiple Range Test (DMRT). Yield and total solid were assessed. The results indicated that the different methods of pasteurization in the cheese-making had no significant effect on yield, but it was affected to total solid of cheese. In summary, pasteurization milk in a cheese making on 63°C for 60 minutes produced good quality of cheese on yield and total solid.

Keywords : cheese, pasteurization method, total solids, yield

1. INTRODUCTION

In recent years, cheese is being a popular food serves high protein content, so the consumption increased. Research data of Fonterra in 2016, the increasing of cheese consumption was 8,1% (Satriani dan Caturini, 2016). The increasing consumption of cheese in Indonesia needs to be balanced with the availability of sufficient and high quality of cheese. Meanwhile, cheese production in Indonesia is still lacking, most of it is imported from other counrties. In 2009, the volume of cheese imports reached 10,602 tons with an average increase of 5.96% per year. For the period August to September 2014, cheese import data was 13,759,701 kg with a cumulative export amount of 667,581 kg (Pusat Data dan Sistem Informasi Pertanian, 2015).

The stages of cheese making are heating the milk (pasteurization), coagulating the casein, separating the curd and whey, pressing and storing. Milk pasteurization methods are divided into two, namely LTLT (Low Temperature Long Time) and HTST (High Temperature Short Time). Pasteurization using the LTLT method is carried out at a temperature of 63°C for 30 minutes, while pasteurization with the HTST method is carried out at a temperature of 72°C for 15 seconds. The appropriate metods of pasteurization process affects the cheese with good product based on yield and quality. Based on the

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description above, it is necessary to conduct research regarding the appropriate methods of milk pasteurization to determine its effect on yield and total solids of cheese.

2. LITERATURE REVIEW

Cheese is a milk-based products with a coagulation process as a prior mechanisms using rennin enzyme. There are so much type of cheese in the world that produce with different process. To make it coagulate, it needs to be added such an acidifier, using direct or indirect method. A direct methods could be done using citric acid, acetic acid, or local plants, then, indirect method using starter culture (Setyawardani et al. 2021; Ismiarti et al., 2023). Process of decreasing pH is conducted with the addition of acidifier substances to make optimum pH for rennin. Nutrition fact of cheese is needed by human body to increase the function of metabolisms pathways. Cheese contains protein 19,4%; fat 21,6%, and carbohydrate 2,20% (Negara *et al.*, 2016).

Pasteurization is a steps of cheese making in order to kill pathogen microorganisms, then longer shelf-life of cheese. It because Standar Nasional Indonesia (2011) requires microbial total of raw milk no more than 6,00 log CFU/g (Ismiarti and Sumarmono, 2023). In general, pasteurization could be done using high temperature short time (72°C for 15 seconds) or low temperature long time (63°C for 30 minutes).

Yield of cheese is a physical parameter shown by percentage, counted by the determination of milk as raw material with cheese produced. A higher amount of yield indicates a higher bioactives compounds on it. It affects to postitive impact of economical aspect with decreasing cost of materials and increasing profitability on cheese manufactures. (Jensen dan Babcock, 2019). Yield percentage is affected by curd produced on coagulating process. Besides, a higher amount of yield also indicates the higher cheese produced. In contrast, a higher whey produced, indicates lower cheese produced (Fadhlurrohman, *et al.,* 2023). A best quality of cheese is the highest yield percentages. Yield of unripened cheese is about 10,67–21,66% (Estikomah, 2017).

3. METHODS

Material used were raw milk 20 liter, skim milk 160 g, animal *rennet* 0,02 ml, and bacterial starter. Equipments used were kitchen set, thermometer, oven, crucible dish, measuring glass, digital balance, and pH meter. The experimental study conducted by a Completely Randomized Design for 4 treatments and repeated 5 times. Data was then analyzed using Analysis of Variance. A significant data was assessed using Duncan's

Multiple Range Test (DMRT).

Starter Culture preparation (Procedure by commercial dried starter bacteria) *Yogourtmert*).

A 10 g of skim milk was diluted with 100 ml of aquadest into beaker glass then heated with stirring until 100 ºC for 15 minutes. The temperature was lowered into 40 ºC and placed in an Erlenmeyer flask, adding 4% commercial Yogourmet starter (*L. bulgaricus, S. thermophilus, L. acidophilus*) and incubated until the pH reached 4.8. The next stage was preparing mother culture for the next starter culture with the same steps.

Milk Pasteurization

Milk pasteurization conducted following Ismiarti and Sumarmono. (2023) with a slight modification. A 20 l of milk was filtered, then divided into 4 parts, with 5 l each part. Milk then pasteurized using 63°C with different time: 30 (P1), 40 (P2), 50 (P3) and 60 minutes (P4).

Cheese Making

Cheese making follows method by Ismiarti et al. (2023). Milk from different pasteurization methods then added by starter culture 4 % (40 ml) each treatments and incubated until the pH was dropped into 6,1-6,2. The next stage was adding 0.02 ml of rennet and stirring gently. Milk then incubated for 2 hours at 37°C. Afterwards, the curd produced was cut, then let it rested. Curd and whey were separated using a filter cloth, only the curd was taken while the whey was discarded (Legowo, 2003). The curd was added with 3% salt, then the curd was pressed for 2 hours with a load of 5 kg wrapped in sterile cloth. The percentage yield and total solids were assessed by the formulas below.

$$\% \text{ Yield} = \frac{\text{curd produced (g)}}{\text{milk as raw material (g)}} \text{ x } 100\%$$

$$\% \text{ Total solid} = 100\% - \% \text{ moisture content}$$

4. RESULTS AND DISCUSSION

The results of cheese yield measurements with different methods of pasteurization (63°C for 30, 40, 50 and 60 minutes) are showed in Table 1.

Table 1. The average of yield and total solids of fresh cheese with different pasteurization methods

Treatment	Average (%)	
	Yield	Total Solid
P1 (30 minutes)	18,19	31,04[a]
P2 (40 minutes)	19,80	45,10[b]
P3 (50 minutes)	21,22	47,62[b]
P4 (60 minutes)	20,23	50,07[b]
Total	19,86	43,46

Note: [a,b]Superscript indicate significant difference within column ($p<0.05$)

Cheese Yield

Data on Table 1 shows that different methods of pasteurization have no significant effect on yield. This is possible because the different methods of pasteurization does not have a significant effect on yield. Sumarmono and Suhartati (2012) stated that the HTST method produces higher yields than LTLT. High temperature of pasteurization resulted in casein denaturation, which determines the effectiveness of rennet during the curding process. In other hand, denatured proteins decrease their ability to bind water, allowing rennet to work more optimally.

The yield of cheese produced is relatively same. It because the different methods of pasteurization of milk in cheese making is not different. Rasuli *et al.,* (2015) stated that the pasteurization in soft cheese production was not affected on cheese yield, but high temperature of pasteurization had a significant effect on cheese yield. It is because each proteolytic enzyme has a different temperature range and heating duration. Further explained by Riahi (2007) that the use of the appropriate temperature and heating duration will have an impact on cheese yield. The yield result from cheese weight loss is caused by water loss due to evaporation and CO_2 release from glycolysis and proteolysis processes and is influenced by relative humidity and ambient temperature.

Curd cutting affects the amount of whey and curd that separated. Curd cutting in P1 and P2 is smaller than P3 and P4. The clumping that occurs in P1 and P2 are not complete perfectly, P3 and P4 are relatively compact. Metzger et al. (2000) suggested that acidic condition are optimum for protease activity can produce a compact and firm curd on coagulation process. On the process of cutting curd, no much fat and casein are lost with the whey. The process of separating whey and curd in this study was about 2 hours, so coagulation was not optimal. Wardhani (1996) stated that coagulation will occur for about 10

hours. Rahmawati (2006) added that cheese yield depends on the length of coagulation, if the time is too short, it causes a reduction in density and protein in the milk to coagulate completely. Mardiani et al. (2013) stated that the smaller the curd pieces, it will produce the larger the surface area and the more whey that is freed during filtration. The amount of whey trapped in the curd causes higher percentage of cheese yield.

Total Solids

Total solids of cheese could be seen in Table 1. The average total solids of treatments P1, P2, P3, and P4 were 31.04%, 45.01%, 47.62%, and 50.07%, respectively. The highest total solids were obtained at 60 minutes of pasteurization (50.07%) and the lowest at 30 minutes of pasteurization (31.04%). The results of the analysis of variance showed that different methods of pasteurization on total solids had a significant effect ($P < 0.05$).

Post-hoc DMRT showed that P1 was significantly different ($P<0.01$) with P2, P3 and P4 treatments. Pasteurization for 60 minutes produces the highest total solids. It because when it is pasteurized, there is evaporation which results in a decrease in milk moisture content. The different methods of pasteurization causes a difference in the water bound of the milk so that the total solids of milk becomes high, which also means that the total solids of cheese produced is high. According to Daulay (1991), water in curd will exchange with each other in the reaction of releasing or attracting water molecules. Watson and Preedy (2010) stated that the process of breaking oligosaccharides into short-chain carbohydrates that have a smaller structure allows the water bound to the carbohydrates to be separated so that the water is wasted along with the whey when filtering the curd. Setiyawan et al. (2015) added that the water content found in cheese is obtained from the water found between fat and protein. If the amount of water bound during cheese making is lower, the cheese fat is higher, if the cheese fat is lower, the amount of water bound in the cheese will be higher. Miskiyah and Broto (2011) also stated that the effect of pasteurization causes a decrease in milk moisture content so that the total solids of the curd produced are low. Evaporation of milk that occurs during heating causes a decrease in water content followed by an increase in total solids.

5. CONCLUSION

The different methods of pasteurization on cheese making did not significantly affect cheese yield, increase total solid of cheese. Pasteurization on 63°C for 60 minutes is the most efficient for the best yiled and total solid of milk.

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