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Full Fat and Low Moisture Part Skim (LMPS) Mozzarella Yield Analysis in PT Mazaraat Lokanatura Indonesia

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ABSTRACT

PT Mazaraat Lokanatura Indonesia is a company engaged in the production of cheese and creamery. In this case we will discuss about the yield of full fat mozzarella and low-moisture part-skim (LMPS) mozzarella produced in PT Mazaraat Lokanatura Indonesia. Various indicators can influence the production process and the cheese yield produced. This research aims to determine the average yield value of full fat mozzarella and low-moisture part-skim (LMPS) mozzarella which can be used to analyze factors that can influence the amount of cheese yield produced. The analysis was carried out by collecting data in the form of cooking temperature (stir & cook), amount of milk used, weight of curd formed, and calculating the yield of full fat mozzarella and low-moisture part-skim (LMPS) mozzarella produced at PT Mazaraat Lokanatura Indonesia. The average yield value for full fat mozzarella was 9.64% and tend to be unstable meanwhile the average yield value for low-moisture part-skim (LMPS) mozzarella was 11.43% with a fairly stable condition. Factors that can influence the yield value of full fat mozzarella and low-moisture part-skim (LMPS) mozzarella are human factors that are less consistent, lack of evaluation, and lack of communication, meanwhile from the method are lack of consistency and accuracy of measurement, also from the material such as milk with variability in fat and protein levels but have not through a standardization process, as well as machine factors such as inappropriate equipment temperatures and less accurate scales used.

Keywords: *Full Fat Mozzarella, Low-Moisture Part-Skim (LMPS) Mozzarella, Yield*

Introduction

Cheese is a dairy product widely consumed due to its rich content of nutrients and beneficial for health. The main component of cheese is casein, with the rest comprising whey, fat, lactose, vitamins, and minerals. The cheese-making process involves the primary ingredient of milk, along with the addition of cultures and rennet, resulting in the separation of curd and whey (Budiman et al., 2017). The curd, which is the result of heating milk that has had enzymes added, determines the yield of cheese (Musra et al., 2021), while whey is a by-product or waste from the cheese-making process (Nursiwi et al., 2015).

Cheese based on their ripening processes are divided into two types: hard cheese that made with aging process and soft cheese that made without aging (Arifiansyah et al., 2014). An example of soft cheese is mozzarella (Mouritsen & Styrbæk, 2017). Mozzarella categorized as pasta filata, characterized by its softness, lack of aging, and readiness for consumption immediately after production (Jana & Tagalpallewar, 2017). Mozzarella also classified based on its fat content. Low-moisture part-skim (LMPS) mozzarella has lower fat

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content than full fat mozzarella because the cheese-making process for LMPS mozzarella uses milk with part of its fat removed (Hui, 2012).

Yield is a critical factor in cheese production. Yield is the ratio between the weight of the raw material, namely the weight of the curd, and the weight of the milk used (Indrarosa & Agustin, 2022). Measuring yield can be used to assess the effectiveness of the production process (Banks, 2007), which in turn determines economic profitability (Rana et al., 2017). Arinda et al. (2013) stated that the curd yield in the mozzarella making process ranges from 11.30–12.93%. Various indicators can affect the production process and the cheese yield produced. This study aims to analyze the factors that can influence cheese yield by collecting data on cooking temperature, the amount of milk used, the weight of the curd formed, and calculating the yield of full fat mozzarella and low-moisture part-skim (LMPS) mozzarella produced in PT Mazaraat Lokanatura Indonesia.

Research Method

This research used a qualitative descriptive method based on a literature review using the following indicators:

1. Sampling

   Samples taken included the weight of milk used as raw material and curd from the coagulation process in the production of full fat mozzarella and LMPS mozzarella at PT Mazaraat Lokanatura Indonesia during 10 days of production.
2. Curd Weighing

   The curd is weighed using a digital scale to determine its weight and considered as the weight of cheese produced.
3. Curd Yield Calculation

   The calculation of curd yield is carried out by converting the milk mass from liters into grams and calculated using the following formula:

$$Yield = \frac{Curd\ Mass\ (g)}{Milk\ Mass\ (g)} \times 100\%$$

4. Data Processing

   The collected datas are processed and presented in the form of tables and charts.

Results and Discussion

The determination of yield is carried out by processing the data obtained during the observation period at PT Mazaraat Lokanatura Indonesia. The data collected includes the amount of milk used and the final cheese weight, allowing the calculation of the yield produced. The yield obtained in the cheese-making process is determined by the amount of curd formed (Yahdiyani et al., 2015). The calculation of cheese yield refers to the

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study conducted by Nugroho et al. (2018), which is based on the ratio between the weight of curd mass that considered as cheese produced in grams and the milk used as the raw material in grams.

Based on the yield obtained from calculations using the formula, an analysis is conducted by referring to the study by Arinda et al. (2013) which states that the yield value of mozzarella cheese ranges from 11.30–12.93%. The analysis is performed using chart with the efficient yield range according to theory such as 11.30% as the upper control limit (UCL) and 12.93% as the lower control limit (LCL). The data and chart for the yield of full fat mozzarella can be seen in Table 1 and Figure 1, while the data and chart for LMPS mozzarella can be seen in Table 2 and Figure 2.

Table 1. Full Fat Mozzarella Data

Sampling	Stir & cook temp. (°C)	Milk used (L)	Milk used (g)	Curd weight (g)	Yield (%)
1	38	150	150,000	19,124	7.84
2	38	120	120,000	11,182	10.73
3	40	100	100,000	10,182	9.82
4	38	150	150,000	17,039	8.80
5	41	120	120,000	14,495	8.28
6	36	230	230,000	20,048	11.47
7	36	200	200,000	18,180	11.00
8	38	200	200,000	18,260	10.95
9	38	160	160,000	19,100	8.38
10	41	100	100,000	10,956	9.13
			Average		**9.64**

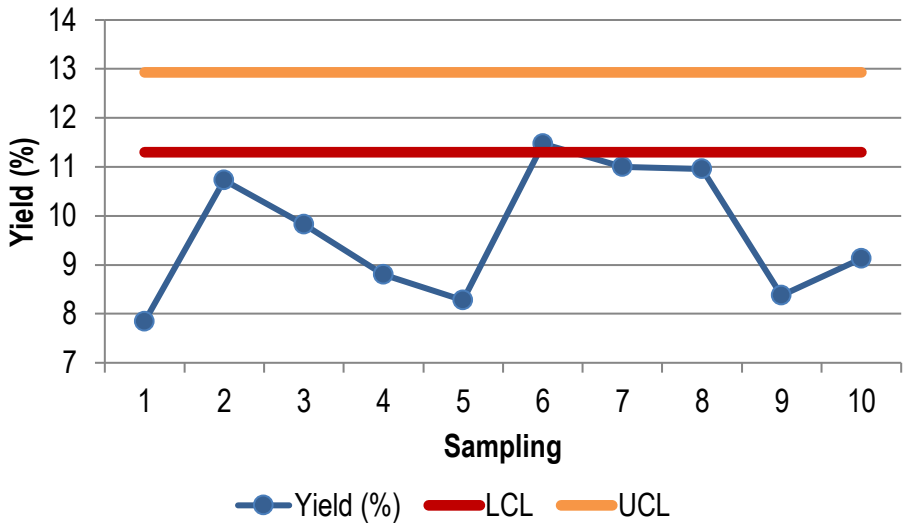

Figure 1. Full Fat Mozzarella Yield Chart

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The yield from the production process of full fat mozzarella cheese at PT Mazaraat Lokanatura Indonesia shows significant variations. Based on these 10 observations, the yield average of full fat mozzarella is 9.64% and ranges from 7.84% to 11.47%. The lowest yield was 7.84% at the first sampling and the highest yield was 11.47% at the sixth sampling. The yield of full fat mozzarella during the observation period tends to be unstable and falls below the lower control limit (LCL).

Table 1. Low-Moisture Part-Skim (LMPS) Mozzarella Data

Sampling	Stir & cook temp. (°C)	Milk used (L)	Milk used (g)	Curd weight (g)	Yield (%)
1	41	200	200,000	18,834	10.62
2	41	200	200,000	18,782	10.65
3	41	200	200,000	16,726	11.96
4	41	200	200,000	18,118	11.04
5	41	200	200,000	18,518	10.80
6	41	200	200,000	16,883	11.85
7	41	300	300,000	25,757	11.65
8	41	200	200,000	16,256	12.30
9	41	300	300,000	26,368	11.38
10	41	200	200,000	16,644	12.02
		Average			**11.43**

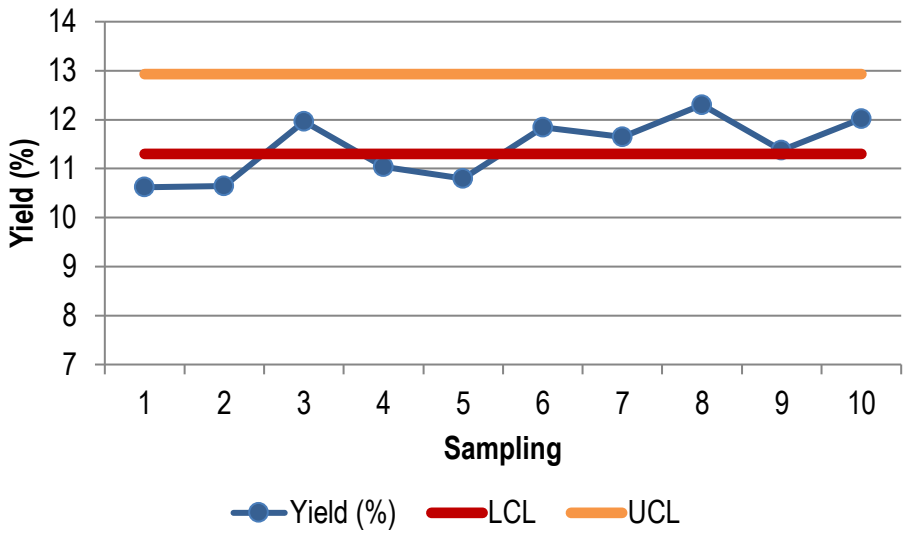

Figure 2. Low-Moisture Part-Skim (LMPS) Mozzarella Yield Chart

The yield in the production process of LMPS mozzarella at PT Mazaraat Lokanatura Indonesia shows a tendency to be stable. Based on 10 observations, the yield average of LMPS mozzarella is 11.43%. and ranges from 10.62% to 12.30%. The lowest yield was 10.62% at the first sampling and the highest yield was 12.30% at

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the eighth sampling. The yield of LMPS mozzarella produced during the observations are stable and mostly remains within the controlled range.

There are several factors that can affect the yield of full fat mozzarella and LMPS mozzarella. The factors are explained using a fishbone diagram, a quality control tool used to detect problems occurring in the company. Fishbone diagram was created with the goal of identifying and grouping the causes which generate a quality problem (Ilie & Ciocoiu, 2010). According to Liliana (2016), the use of the fishbone diagram involves four steps: identifying the problem, determining the main factors involved, identifying possible causes, and analyzing the diagram. The fishbone diagram can be seen in Figure 3.

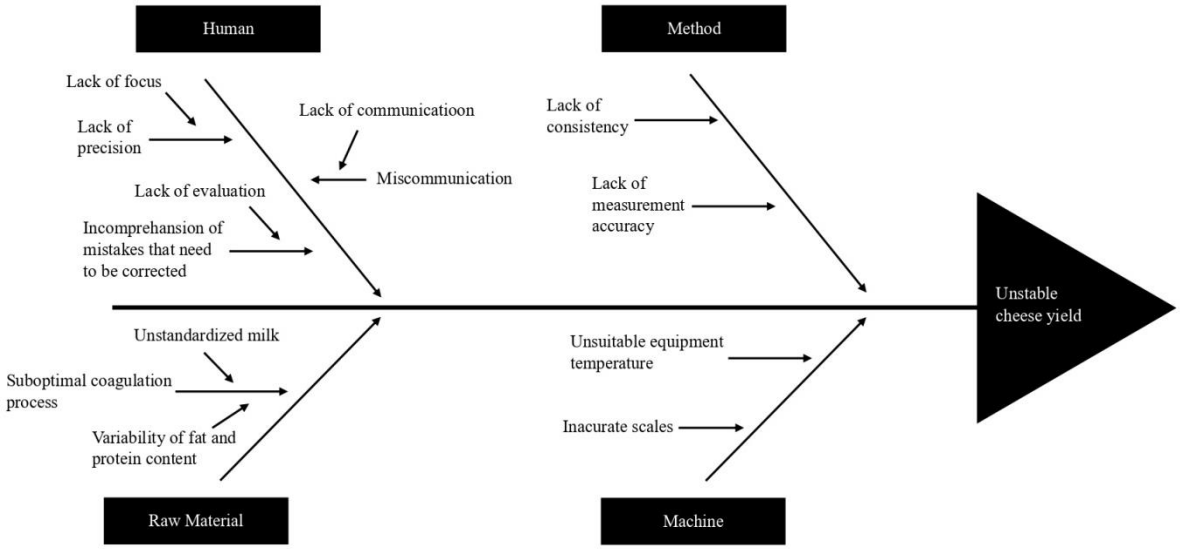

Figure 3. Fishbone Diagram

Four factors that can affect the instability of the cheese yield produced are included on analysis using fishbone diagram such as human, method, raw material, and machine. These factors affects each other, leading to instability in the yield produced. The detailed explanations of these factors are as follows:

1. Human

   Human can cause errors in the production process (Sembiring et al., 2019). This can happen due to lack of attention caused by the workers' lack of focus. Poor communication among workers can also lead to incompatibility in the production process. Additionally, lack of evaluation can cause the lack of understanding the errors that need to be corrected, causing repeated mistakes. Livia and Pramono (2016) state that training for technicians or process operators should be prioritized to improve knowledge, skills, attitudes, and work behaviors.

2. Method

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The application of inappropriate methods can be influenced by several factors. Lack of consistency can cause unstable cheese yield due to differences procedure applied in each production process. Additionally, inaccurate measurements can contribute to the instability of cheese yield. According to Treville et al. (2005), requiring employees to perform their tasks according to Standard Operating Procedures (SOPs) can improve production outcomes in the context of repetitive manufacturing.

3. Raw Material

One of the most important factors in producing good quality products is based on the raw materials (Zugarramurdi et al., 2004). The composition and quality of milk as the raw material, such as fat and protein content of the milk, can affect the cheese yield and the efficiency of the process (Fox et al., 2017). Fat and protein in milk plays a crucial role in determining the cheese yield. When the fat content in milk decreases, cheese yield is significantly affected. Fat contributes to 50% or more of the dry weight of cheese yield (Sattar et al., 2015). Based on the yield data, the average yield of full fat mozzarella is lower than the average yield of LMPS mozzarella. The result does not align with the theory that full fat mozzarella with higher fat content should have a higher yield than LMPS mozzarella.

4. Machine

Machines can determine the quality of production (Jasasila, 2017). Inappropriate use of machines can cause in suboptimal cheese production. The temperature applied during the stir & cook stage for full fat mozzarella varies from 36–41°C, while the stir & cook temperature for LMPS mozzarella is consistently at 41°C. Lower cooking temperatures result in lower syneresis, leading to higher moisture content in the final cheese product (Kindstedt, 2007). According to this theory, inconsistent and too-low temperatures during cheese production result in inadequate curd coagulation, producing curds with high moisture content and poor quality due to excessive water content. Additionally, using different scales for measuring the final weight can lead to inaccurate measurements, affecting yield calculations. Fritsch (2021) states that cccurate weighing results are key for quality control and production processes

The yield instability during production of full fat mozzarella can be addressed by several efforts, including:

1. Maintaining consistent cooking temperatures

According to the theory by Kindstedt (2007), lower cooking temperatures result in lower syneresis, leading to higher moisture content in the final product. Mozzarella with high moisture content can cause problems such as soft texture and susceptibility to unwanted microbial contamination (Johnson & Sommer, 2020). Therefore, cooking at appropriate temperatures is necessary to optimize the syneresis process. This way, moisture content can be controlled and yield can be maximized.

2. Homogenization

Fox et al. (2004) states that high fat content in milk can reduce the syneresis process, so standardizing the fat content in milk is necessary. Homogenizing milk for cheese production can help prevent fat or serum separation during storage. Milk is typically homogenized at pressures ranging from 10–20 MPa at temperatures of 55–65°C with prior heating treatment. Homogenization reduces the size of fat globules, increases the moisture content of cheese and cheese yield, and affects protein structure and causes casein micelles and whey proteins to become associated with the fat globule membrane (Widodo, 2021). Homogenization increase cheese fat content (Juniawati et al., 2015) which also indicates an increase in yield since milk fat influenced the mozzarella cheese yield (Sales et al., 2021).

Conclusion

The conclusion of this study is that the average yield of full fat mozzarella cheese is 9.64%, while the average yield of low-moisture part-skim (LMPS) mozzarella cheese is 11.43%. The average yield of full fat mozzarella cheese at PT Mazaraat Lokanatura Indonesia tends to be unstable, whereas the yield of low-moisture part-skim (LMPS) mozzarella cheese is relatively stable. Factors that can affect the yield of full fat mozzarella and low-moisture part-skim (LMPS) mozzarella include human factors such as lack of attention to detail, insufficient evaluation, and poor communication. Method factors include lack of consistency and measurement accuracy. Raw material factors involve the variability in fat and protein content of the milk without undergoing standardization. Machine factors include inappropriate equipment temperature and inaccurate scales used for measurement.

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