

# The physical quality of cream cheese influenced by the addition of encapsulated *Lactococcus lactis*

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**Abstract.** This study aimed to determine the best treatment of *Lactococcus lactis* encapsulated with gelatin and Na-Alginat at different concentrations of : T\_0 0% had (w/v); T\_1 1% had (w/v); T\_2 2% had (w/v), and T\_3 3% had (w/v). The research was conducted in Animal Product Technology Laboratory. The material used was cream cheese made from pasteurized milk and added *Lactococcus lactis* starter culture encapsulated. *Lactococcus lactis* starter was obtained from the Center for Food and Nutrition Studies, Gadjah Mada University, encapsulated with Haqiqi brand beef gelatin and Food Grade brand Na-alginate. The method of this research was an experimentally designed completely randomized design (CRD) with four treatments and three replications. The parameter observed in this research were water content, water binding power, syneresis, free oil, emulsion stability, emulsion activity, emulsion index, and turbidity of cream cheese. The result showed that the addition of *Lactococcus lactis* encapsulated did not have a significant effect on water content, water binding power, syneresis, free oil, emulsion stability, emulsion activity, emulsion index, and turbidity of cream cheese ( $P>0.05$ ). It can be concluded that the best cream cheese was achieved with the addition of 3% *Lactococcus lactis* encapsulated with the 55.11% water content, 76.80% water holding capacity, 19.03% syneresis, 45.28% free oil respectively, 64.88% emulsion stability, 1.54 m<sup>2</sup>/g emulsion activity, 3,68% emulsion index, and 2.19% turbidity.

**Keywords :** Cream Cheese. *Lactococcus lactis*. Encapsulated

## 1 Introduction

Cream cheese is a type of soft cheese rich in nutrients that has a soft, smooth, white and creamy texture and a sour taste [1]. The process of making cream cheese uses the main ingredient, namely skim milk, which is pasteurized with the addition of lactic acid bacteria [2]. The lactic acid bacteria used in this research were *Lactococcus lactis*. The purpose of adding *Lactococcus lactis* to cream cheese is as a fermentation starter [3], improving the distinctive taste and aroma, appearance, color, and texture [4]. *Lactococcus lactis* is a lactic

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acid bacterium that is sensitive to extreme environments [5], so it can cause the loss of the functional life of the bacteria. In order for *Lactococcus lactis* to work well, it requires the right growth temperature, so it needs a coating treatment using encapsulation technology with the technique of entrapping the core material in a certain coating material. Encapsulation is an immobilization technique that protects active ingredients in a matrix from environmental influences. Microencapsulation of probiotic bacteria often uses a matrix in the form of Na alginate and gelatin. Na alginate has been tested to increase probiotic survival by 80-95%. Immobilization of *Lactococcus lactis* bacteria in alginate and gelatin makes the bacteria surrounded by a gel network, which limits the movement of the bacteria. When growth occurs, bacteria press on the gel network, and bacterial colonies are formed [5]. As the colony grows, bacteria can reach the surface of the alginate beads. This can lead to a colony eruption, resulting in the colony being released into the environment.

Cream cheese has a standard water content for fresh cheese, namely a maximum of 80% [6]. In the process of making cream cheese, there is a process of increasing the total amount of acid, which triggers a decrease in pH, resulting in the cream cheese experiencing an increase in water holding capacity and low syneresis. The quality of cream cheese seen during storage can affect free oil. Free oil formation or fat leakage is the tendency of liquid fat to separate from the melted cheese and accumulate as pockets of oil, especially on the surface [7]. The use of encapsulated *Lactococcus lactis* resulted in decreased emulsion stability in cream cheese, increased emulsion activity, and increased emulsion index and turbidity values. The decrease in emulsion stability is caused by protein denaturation along with decreasing pH during storage, which causes damage to protein bonds as an emulsifying agent [8]. The addition of encapsulated *Lactococcus lactis* to cream cheese is a solution to produce quality cream cheese because its viability is stable in the external environment, thereby reducing the risk of damage to food ingredients [9].

## 2 Materials and Methods

### 2.1 Materials

The material used in this research was cream cheese made from pasteurized milk and added *Lactococcus lactis* starter culture. The ingredients used in this research were powdered skim milk (Super) and added with *Lactococcus lactis* starter (obtained from the Center for Food and Nutrition Studies, Gadjah Mada University) encapsulated with Haqiqi brand beef gelatin and Food Grade Na-alginate, rennet enzymes (QSO), 0.1 M Catalog brand, and table salt (NaCl) (Ship Stamp).

### 2.2 Methods

The research method used was a laboratory experimental method using a completely randomized design with 4 treatments and 3 replications which added an encapsulated *Lactococcus lactis* starter culture with the variables observed being water content, water holding capacity, syneresis, free oil, emulsion stability, emulsion activity, emulsion index, and turbidity. Data were analyzed using Analysis of Variance (ANNOVA) with the Completely Randomized Design (CRD) method. If there are differences then they are analyzed further using Duncan's Multiple Distance Test (UJBD).

## 3 Results and discussion

### 3.1 Effect of Using Encapsulated *Lactococcus lactis* in Cream Cheese on Water Content

Data and analysis of variations in the average water content of cream cheese with different treatments using encapsulated *Lactococcus lactis* bacteria can be seen in Table 1.

**Table 1.** Average water content (%) with different encapsulated *Lactococcus lactis* addition treatments.

Treatments	Water Content (%)
P0	53.50 ±0.05 <sup>a</sup>
P1	54.50 ±0.13 <sup>a</sup>
P2	55.11 ±0.09 <sup>b</sup>
P3	55.98 ±0.47 <sup>c</sup>

Note: a, b, and c different superscripts in the same column show very significant differences in water content ( $P < 0.01$ ).

The results of the analysis of variance showed that the treatment using encapsulated *Lactococcus lactis* had a very significant effect ( $P < 0.01$ ) on the water content of cream cheese. Table 1 shows the average water content between 53.50% and 55.98%. The water content of cream cheese tends to increase with an increasing concentration of encapsulated *Lactococcus* as a starter in making cream cheese. The control sample (P0) with the addition of *Lactococcus lactis* without encapsulation had a low water content among all treatments, namely 53.50%. This was because the lactic acid produced was low due to the decreased viability of *Lactococcus lactis* due to its lack of bacterial resistance in vulnerable and extreme environments. protective layer because *Lactococcus lactis* is a non-sporulative gram-positive bacteria [10]. In P1, P2, and P3, there was an increase due to the increasing ratio of the addition of encapsulated *Lactococcus lactis*. The highest average water content was found in the P3 treatment, namely 55.98%. The higher the concentration, the more the addition of encapsulated *Lactococcus lactis* tends to increase the water content. Water content is free water and adsorbed water, where the adsorbed water is water bound in hydrocolloid networks [11].

The greater the amount of *Lactococcus lactis* added, the higher the lactic acid produced, resulting in milk proteins clumping and releasing water. This event is also related to syneresis. The release of water increases the water content of the cream cheese. Stated that water separation occurs due to LAB activity, which produces proteolytic enzymes in an acidic atmosphere, and clumping occurs. This is due to the presence of hydroxyl in the encapsulant material (Na alginate and gelatin), which has a tendency to bind water so that the water content becomes high [12]. The water content of all treatments in cream cheese is 53–55.98%, so the resulting cheese is included in the soft cheese group. [13] states that the water content in soft cheese ranges from 40–75%. [14] the water content of cream cheese is  $\leq 55\%$ , so the best treatment is P1 and P2 because they are included in the cream cheese standard. Soft cheeses are generally consumed fresh and have a limited shelf life. High water content can weaken the casein network so that cheese particles can easily separate [15].

### 3.2 Effect of Using Encapsulated *Lactococcus lactis* in Cream Cheese on Water Holding Capacity

Data and analysis of the average holding capacity of cream cheese water with treatment using encapsulated *Lactococcus lactis* bacteria can be seen in Table 2.

**Table 2.** Average water holding capacity with different encapsulated *Lactococcus lactis* addition treatments.

Treatments	Water Holding Capacity (%)
P0	75.19±0.74
P1	75.32±1.22
P2	76.80±0.56
P3	76.37±1.32

The results of the analysis of variance showed that the treatment using encapsulated *Lactococcus lactis* did not make a significant difference ( $P > 0.05$ ) to the water holding capacity of cream cheese. Table 2 shows that the treatment of adding encapsulated *Lactococcus lactis* to cream cheese has an average water holding capacity ranging from 75.32% to 76.80%. In P1 and P2, there was an increase in water holding capacity. This was due to the addition of a large number of encapsulated *Lactococcus lactis*, where the encapsulant in *Lactococcus lactis* contained gelatin and Na-alginate as stabilizers, which affected the water holding capacity of cream cheese. Casein micelles have the ability to bind large amounts of water. Mechanical water trapping plays a role in increasing water holding capacity [16]. There was a slight decrease in water holding capacity in P3 due to the influence of the lack of protein binding in gelatin as an encapsulant compared to Na-alginate in comparison to *Lactococcus lactis* encapsulation. Decreased protein-water interactions will result in aggregation and precipitation due to the release of water from the protein network [16]. The addition of gelatin can increase water holding capacity. This is because gelatin functions as a stabilizer, inhibiting hydrogen bonds and increasing the hydrophilic properties of proteins [17]. Giving 2% encapsulated *Lactococcus lactis* (P2) to cream cheese namely, 76.80%, is the best treatment because it is able to increase water holding capacity optimally.

The protein contained in the encapsulant will increase the amount of protein contained in the cream cheese so that more water is bound because the casein molecule in the cream cheese experiences a change in negative ion charge to positive. This event will result in an interaction inhibiting hydrogen bonds between the casein molecule and the lactic acid molecule. Manab [16] stated that the water-holding capacity of yogurt is influenced by casein micelles. The casein molecule in cream cheese experiences a change in negative ion charge to positive; this event will result in an interaction inhibiting the hydrogen bond between the casein molecule and the lactic acid molecule. [17] argue that casein and lactic acid do not bond with each other because the ion charge is the same, which can inhibit hydrogen bonds between casein molecules and lactic acid molecules and maintain the binding of water molecules by protein molecules. Water molecules are suspended in the semi-solid phase due to hydrogen bonds (C == H) between water molecules and protein amide groups (N -- H), and interactions between water molecules and ionic groups to form a hydration structure consisting of hydrogen bonds between water molecules.

### 3.3 Effect of Using Encapsulated *Lactococcus lactis* in Cream Cheese on Syneresis

Data and analysis of the average variance of cream cheese syneresis with different treatments using encapsulated *Lactococcus lactis* bacteria can be seen in Table 3.

**Table 3.** Average syneresis with different encapsulated *Lactococcus lactis* addition treatments.

Treatments	Syneresis (%)
P0	26.09±1.14 <sup>b</sup>
P1	21.58±2.84 <sup>ab</sup>
P2	19.03±0.71 <sup>a</sup>
P3	21.97±0.35 <sup>ab</sup>

Note: a and b different superscripts in the same column show very significant differences in syneresis ( $P < 0.01$ ).

Based on Table 3, it can be seen that the amount of syneresis ranges from 19.03% to 26.09%. The results of the analysis of variance showed that the addition of encapsulated *Lactococcus lactis* with different treatments had a very significant effect ( $P < 0.01$ ) on cream cheese syneresis.

One of the main determining factors for the quality of cream cheese is syneresis. Syneresis is a gel shrinkage event that occurs naturally without external force or pressure. This is related to unstable gel bonds, which result in a loss of whey binding ability [18]. The breaking and formation of casein bonds affect the syneresis behavior of the product, namely the release of whey. According to [16] the occurrence syneresis is caused by changes in casein solubility and the shrinkage of casein particles. Curd cutting and pressing can also influence syneresis [19].

Based on the results of research, cream cheese treated with encapsulated *Lactococcus lactis* (P1, P2, and P3) experienced a decrease in syneresis compared to the control treatment with the addition of non-encapsulated *Lactococcus lactis* (P0). At P0, it has a higher level of syneresis because it is influenced by a higher serum release factor due to the reduced viscosity in the water phase of the cream cheese. P2 with an added concentration of 2% encapsulated *Lactococcus lactis* showed the lowest syneresis, namely 19.03%, so treatment P2 was the best treatment among the other treatments because it was close to the syneresis of commercial cream cheese. According to [18], 15 samples of commercial cream cheese had an average syneresis value of 14.4%. The increase in P3 again is probably due to the large amount of lactic acid metabolism products coming out of the encapsulant pores due to the lack of binding to the protein from gelatin, which can completely encapsulate the pores of the microencapsulation membrane due to the small ratio between gelatin and Na-alginate (1:3). Low protein solubility is easily released so that it comes into direct contact with the environment, causing protein-protein interactions from lactic acid acidification, so the tendency for syneresis to occur cannot be inhibited [16].

The syneresis value in cream cheese is reduced because *Lactococcus lactis*, which is used as a starter in making cream cheese, is coated with an encapsulant coating containing gelatin and sodium alginate, which is able to form peptide bonds with casein and prevent hydrogen bonds between casein and lactic acid in acidic conditions, which can result in increasing water holding capacity and reducing syneresis. [20] reported that yogurt syneresis was influenced by the addition of stabilizer concentration, caused by a highwater holding capacity, which could reduce syneresis.

### 3.4 The Effect of Using Encapsulated *Lactococcus lactis* in Cream Cheese on Free Oil

Data and analysis of the average variance of free-oil cream cheese with different treatments using encapsulated *Lactococcus lactis* bacteria can be seen in Table 4.

**Table 4.** Average free oil with different encapsulated *Lactococcus lactis* addition treatments.

Treatments	Free Oil (%)
P0	45.61±0.34
P1	46.79±2.22
P2	45.28±0.13
P3	44.58±0.42

Based on Table 4, it can be seen that the amount of free oil ranges from 44.58% to 46.79%. The results of the analysis of variance showed that the treatment using encapsulated *Lactococcus lactis* did not provide a significant difference ( $P > 0.05$ ) to the free oil in cream cheese. Free oil is also known as oiling off or fat leakage. Free oil is expressed as a percentage of cheese or cheese fat. In each treatment, it was seen that each addition of encapsulated *Lactococcus lactis* to cream cheese did not reduce the free oil much. In P1, P2, and P3, there was a decrease in free oil due to the formation of a complex bond between gelatin and sodium alginate, thus preventing fat leakage. Free oil occurs when the casein matrix collapses during heating, allowing fat globules to coalesce and flow to the surface [21]. The formation of free oil in cream cheese is also influenced by fat globules. The smaller the size of the fat globule, the smaller the free oil produced, and the formation of free oil depends on varying fat mobility [22].

According to [7], the low quantity of oil released causes the formation of emulsions in fat, resulting in reduced fat content in cheese. The more free oil that comes out, the more it will affect the quality of the cream cheese. The longer storage can also affect the increase in free oil. [23] believes that the oil released comes from larger fat globules, which are unstable as emulsion droplets in cream cheese.

### 3.5 Effect of Using Encapsulated *Lactococcus lactis* Cultures in Cream Cheese on Emulsion Stability

Data and results of statistical analysis of the average value of emulsion stability using encapsulated *Lactococcus lactis* culture in cream cheese can be seen in Table 5.

**Table 5.** Average emulsion stability (%) using culture *Lactococcus lactis* encapsulated in cream cheese.

Treatments	Emulsion Stability (%) ± SD
P0	88.39±1.27
P1	87.96±0.96
P2	82.99±8.64
P3	64.88±3.47

In Table 5, the results of the ANOVA test show that the treatments given showed that there was no significant difference ( $P > 0.05$ ) in the stability of the emulsion. The use of encapsulated *Lactococcus lactis* cultures resulted in decreased emulsion stability. According to [24], emulsion stability is the ability of the emulsion to remain stable and unchanged against coalescence and flocculation and to form cream quickly. Factors that influence emulsion stability are temperature during the emulsification process, pH, emulsification viscosity, and the amount and type of soluble protein [25].

The average value of emulsion stability when using *Lactococcus lactis* culture encapsulated in cream cheese ranges from <64.88% to >88.39%. The research results are

comparable to those of [26], who found that the best treatment was the emulsion stability value of guava juice probiotic drink samples on various variations of sucrose and skim milk with the addition of *Lactobacillus casei* starter, namely with an average value ranging from 71% to 100% and a decrease in the value of emulsion stability. In this study, the higher the use of encapsulated *Lactococcus lactis* culture, the lower the emulsion stability value. According to [8], the decrease in emulsion stability is caused by protein denaturation, as the pH decreases during storage and causes damage to protein bonds as an emulsifying agent. The capacity of encapsulated *Lactococcus lactis* to stabilize emulsions depends on the molecular composition of the cell wall and the resulting surface properties. *Lactococcus lactis* can be dispersed in water but not in oil, but when high-cell surface hydrophobic molecules are mixed with hydrocarbons, they will disappear from the water phase and find the oil-in-water interface of the emulsion formed [27].

[28] explains that the fermentation process using skim milk will produce high levels of lactic acid due to the high protein content in skim milk. Increasing lactic acid levels cause the pH to drop so that casein becomes unstable and coagulates to form a gel. Acid coagulation causes the stability of casein to be disturbed and can modify the internal bonds between proteins, causing protein aggregation and denaturation, which will also increase the hydrophobic properties and form a gel-like texture [29]. The ability of proteins to form and stabilize emulsions is a critical factor in food processing. The decrease in emulsion stability is caused by the process of replacing casein with phospholipids that are adsorbed on the surface of oil globules [30]. Low emulsion stability will cause the emulsion to separate quickly and also be damaged.

### 3.6 Effect of Using Encapsulated *Lactococcus lactis* Cultures in Cream Cheese on Emulsion Activity

Data and results of statistical analysis of the average value of emulsion activity using encapsulated *Lactococcus lactis* culture in cream cheese can be seen in Table 6.

**Table 6.** Average emulsion activity ( $m^2/g$ ) using culture *Lactococcus lactis* encapsulated in cream cheese.

Treatments	Emulsion Activity (%) ± SD
P0	1.22±0.15
P1	1.36±0.27
P2	1.45±0.40
P3	1.54±0.38

In Table 6, the results of the ANOVA test show that the treatments given showed that there was no significant difference ( $P > 0.05$ ) in the emulsion activity. The use of encapsulated *Lactococcus lactis* culture resulted in increased emulsion activity. [31] explain that emulsion activity is the area between the surfaces of oil globules with protein stabilization, which can show the emulsion index by calculating the area between the surfaces stabilized per unit mass of protein ( $m^2/g$ ). Factors that influence activity are the amount of pectin and protein bound to the structure [32].

The average value of emulsion activity when using *Lactococcus lactis* culture encapsulated in cream cheese ranges between  $<1.22 m^2/g - >1.54 m^2/g$ . This is comparable to [33] that the value of emulsion activity in the fortification of synbiotic yoghurt with red dragon fruit peel extract (*Hylocereus polyrhizus*) and stevia on emulsion and color properties

is around 7.68–9.4040 and has increased value on emulsion activity. In this study, the higher the use of encapsulated *Lactococcus lactis* culture, the greater the emulsion activity value. [31] explained that the increase in the emulsion activity value was caused by the hydrophobic and hydrophilic groups moving more easily to the surface. The higher the emulsion activity value shown, the higher the protein emulsification ability. The higher the emulsion activity, the smaller the size of the oil globules in the emulsion.

The addition of encapsulated *Lactococcus lactis* also causes the pH of cream cheese to be low. A low pH and a value far from its isoelectric point can cause the protein to release and contain exopolysaccharides. Exopolysaccharides are able to bind water during storage, thereby maintaining a soft texture in gel products [34]. [35] stated that a low pH and a value far from the isoelectric point can also increase solubility so that it can increase the interaction of electron charges in the encapsulation molecules with oil and water molecules in the emulsion system. This causes the emulsion formed from the use of encapsulation to have high emulsion activity.

The casein contained in cream cheese is an amphoteric compound that can react with acids and bases. Casein molecules have positive and negative charges; when proteins and polysaccharides carry opposite charges, they will form complex agglomerations that are soluble or insoluble [36]. According to [37], high total dissolved solids can trigger an increase in emulsion activity.

### 3.7 Effect of Using Encapsulated *Lactococcus lactis* Cultures in Cream Cheese on the Emulsion Index

Data and results of statistical analysis of the average value of the emulsion index using encapsulated *Lactococcus lactis* culture in cream cheese can be seen in Table 7.

**Table 7.** Average emulsion index (%) using encapsulated *Lactococcus lactis* culture in cream cheese.

Treatments	Emulsion index (%) ± SD
P0	2.46±0.60
P1	3.13±0.005
P2	3.17±0.015
P3	3.68±0.35

In Table 7, the results of the ANOVA test show that the treatments given show that there is no significant difference ( $P > 0.05$ ) in the results of the emulsion index. The use of encapsulated *Lactococcus lactis* culture resulted in an increase in the emulsion index. According to [38], the quality of uniformity of a dispersion is an indication of the emulsion index. A small emulsion index value indicates a narrow particle size distribution, which means the particle size is more uniform. Factors that influence the emulsion index are seen in the average volume and diameter of the fat globules. Smaller fat globules can contribute to the overall continuity of the matrix by acting as fillers, resulting in a product with a stronger structure [39].

Average emulsion index value when using culture *Lactococcus lactis* in cream cheese ranges from < 2.46% - >3.68%. This is comparable to [40] that the emulsion index value for the potential of *Bacillus cereus* in biosurfactant production is 44.83%–51.5%, and the value of the emulsion index has increased. The use of encapsulated *Lactococcus lactis* at higher concentrations plays a significant role in increasing the viscosity of the emulsion so that the

total dissolved solids or viscosity also increases [41]. The addition of encapsulated *Lactococcus lactis* will cause an increase in milk acidity, which can cause a low pH, and the release of protein, which is replaced by exopolysaccharide compounds, which can cause the gel texture to become denser so that the absorbance value decreases [42]. The more stable the emulsion, the oil droplets will spread relatively more evenly with a more uniform size and not experience as many droplets coalescing [38].

### 3.8 Effect of Using Encapsulated *Lactococcus lactis* Cultures in Cream Cheese on Turbidity

Data and results of statistical analysis the average value of turbidity using encapsulated *Lactococcus lactis* culture in cream cheese can be seen in Table 8.

**Table 8.** Average turbidity (NTU) using encapsulated *Lactococcus lactis* culture in cream cheese.

Treatments	Turbidity (NTU) ± SD
P0	1.68±0.74
P1	1.72±0.20
P2	1.74±0.98
P3	2.19±0.61

In Table 8, the results of the ANOVA test show that the treatments given showed that there was no significant difference ( $P > 0.05$ ) in turbidity. The use of encapsulated *Lactococcus lactis* cultures resulted in increased turbidity. [38] explain that turbidity is turbidity that occurs due to the presence of suspended substances. Factors that influence turbidity are the content of cellulose, hemicellulose, lignin, starch, and water-soluble carbohydrates [43].

The average turbidity value of using encapsulated *Lactococcus lactis* in cream cheese ranges from <1.68 NTU to >2.19 NTU. This is comparable to [33] that the turbidity value in the fortification of synbiotic yoghurt with red dragon fruit peel extract (*Hylocereus polyrhizus*) and stevia on emulsion properties and color ranges from 0.43 to 0.53 and there is an increase in the value of turbidity. In this research, the higher the use of encapsulated *Lactococcus lactis* in cream cheese, the higher the turbidity value. The use of encapsulated *Lactococcus lactis* in cream cheese is thought to increase the activity of lactic acid bacteria in producing organic acids, thereby increasing turbidity. [44] explained that turbidity can increase, which is influenced by the time the electrocoagulation process takes place. The faster the oxidation and reduction process takes place, it makes it difficult to remove particulates, and the more turbid the liquid waste becomes, plus the increase in voltage applied during the electrocoagulation process will also increase the potential. chemical energy produced. The chemical energy produced is in the form of  $Al^{3+}$  ions at the anode, which acts as a coagulant. The more the amount of coagulant increases, the more flocs will be deposited. Gelatin as a coating material in encapsulated *Lactococcus lactis* cultures can cause a rough and lumpy texture. Gelatin can increase water binding capacity by means of electrostatic interactions with casein molecules so that hydrophobic interactions can be inhibited in non-polar molecules or molecules that have non-polar groups fused together due to the acidification process [17].

## 4 Conclusion

In conclusion, P2 adding 2% encapsulated *Lactococcus lactis* starter to cream cheese can increase the water content and water holding capacity and reduce syneresis and free oil. The addition of 2% encapsulated *Lactococcus lactis* produces cream cheese with a water content of 55.11%, a water holding capacity of 76.80%, syneresis of 19.03%, and free oil of 45.28%. Treatment P3 (3% encapsulated *Lactococcus lactis*) is the best treatment for emulsion stability, emulsion activity, emulsion index, and turbidity, with an average value of emulsion stability of 64.88% and emulsion activity of 1.54%.  $m^2/g$ , emulsion index 3.68%, and turbidity 2.19 NTU.

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