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ARTICLE

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EFFECT OF STARTER YOGHURT IMMOBILIZATION WITH DIFFERENT TYPES AND CONCENTRATION OF HIDROCOLLOIDS ON YOGHURT QUALITY

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Abstract

The purpose of this research was to determine the type and concentration of hydrocolloid are right in the immobilization process starter yoghurt.

This research conducted is to determine the correlation between the type of hydrocolloids and hydrocolloid concentration in starter immobilized. The experimental design used was a randomized block design. The factors used are the type of hydrocolloid a_1 = Sodium Alginate, a_2 = Bacto Agar, a_3 = Carrageenan and hydrocolloids concentration = 1% b_1, b_2 = 3%, b_3 = 5%. The response in the research include chemical responses (analysis of lactic acid levels and pH), the physical response (viscosity), and organoleptic (oddor, consistency and taste).

The results showed that the average levels of lactic acid from first fermentation up to fourth fermentation is 1.32%, 1.07%, 0.87% and 0.90%. The average pH in the fermentation to-1 to 4 is 3.69, 3.72, 4:18, and 4256. the average viscosity of the fermentation 1st to 4th is 4.54 dPa.s, 4:05 dPa.s, dPa.s 4:08, and 4:27 dPa.s.

Research results show that the types of hydrocolloid influence on lactic acid levels yogurt on second fermentation, the viscosity on first and second fermentation, and also on the taste of yogurt, but does not give effect to the pH, whereas the concentration of hydrocolloid has no effect on all parameters of the response.

The selected treatment is the a_2b_2 treatment (Bacto Agar 3%) with an average content of lactic acid produced in yoghurt is 1%, pH 3.94, and a viscosity 4.1 dPa.s.

Keywords: immobilization of yoghurt's starter, matrix immobilized, hydrocolloid, yoghurt.

1. Introduction

Yoghurt is a healthy drink made from fermented cow's milk. The term yogurt comes from the Turkish language, which means sour milk. According to SNI, yoghurt is a fermented product obtained from milk and milk reconstitution by using the bacteria Lactobacillus bulgaricus and Streptococcus thermophillus and lactic acid bacteria or other appropriate, with / or without the addition of other foodstuffs and food additives are permitted. Yoghurt is made through a fermentation process using a mixture of Lactobacillus bulgaricus and Streptococcus thermophillus, that can break down the milk sugar (lactose) into lactic acid. The presence of lactic acid that causes sour yoghurt. Specific aroma of yoghurt consists of components with diacetil carbonyl and acetaldehid dominant (Belitz and Grosch, 1987 in Hasibuan, 2012).

Distribution of starter yogurt is usually carried out in a dry form, for longer durability when compared to the starter in liquid form. Starter is an important part in the manufacture of yoghurt. The culture must be free from contamination, fast growth, producing a distinctive flavor, texture and nice shape, is resistant to bacteriophages and antibiotics (Koswara, 2009).

Generally, the manufacture of yoghurt using a starter in dry form or liquid with the use of one-time use, as a new innovation for the manufacture of yoghurt, the starter that will be used is not in the dry or liquid form, but by immobilizing the starter which starter will be invested in the hydrocolloid.

Immobilized enzymes are enzymes that are physically located in an area or space, so it can withstand the catalytic activity and can be used repeatedly and continuously. (Chibata, 1978 in Hartoto 2008).

Immobilized enzyme is a method of confinement enzyme, where the enzyme is attached to an inert material, the material is not soluble such as sodium alginate, it can increase the resilience of enzymes to environmental changes such as changes in pH or temperature changes, and allow the enzyme to be put in a place where the latter enzyme these can be separated easily from the product and can be reused. The use of enzymes as industrial biocatalysts generally require immobilization to simplify the control of the reactor, in order to avoid contamination of the product, and mostly to recover and reuse the enzymes in many reactions (Goel, 1994 in Merch, 2011).

Advantages of immobilization according Hartoto (2008) was able to be used repeatedly, better stability with ties to the immobilization, can be used for analytical purposes, such as determining the age of the middle of the enzyme and the estimated decrease in activity, can be used for a continuous process and better control.

The use of gel as matrix immobilization can be used both for trapping system (entraping) and binder. Trapping methods, the factors that must be considered for the immobilization of enzymes is a matrix that is used and the bond between the enzyme and the matrix. The materials most widely used as the immobilization matrices are polysaccharides, polyacrylamide and carrageenan, polyacrylamide of the three materials are materials supporting the most stable and does not significantly affect the properties of the enzyme (Goel, 1994 in Merch, 2011).

There are many factors that influence the formation of hydrocolloid gel, these factors can stand alone or connected to one another so that the effect is very complex. Among these factors the most prominent is the concentration, temperature, pH, and the presence of other active components (Pertiwi, 2014).

2. Research Methods

Materials used in this research was the starter yogurt (obtained from the Laboratory of Food Technology and Columbia Store), sodium alginate, bacto agar, carrageenan, 0.85% NaCl, milk, skim milk and water.

The tools used in the research process, bowls, spoons, spatulas, pots, gas stove, ice-

cube trays (size 4x4x3 cm). The tools used for the analysis of the levels of lactic acid, pH meter and visco tester.

Preliminary Research

Preliminary research conducted is testing a total of microbes in each different starter using TPC (Total Plate Count) and the selection of yoghurt starter different (Laboratory TP and Columbia) on the immobilization process starter will be embedded in a single type of hydrocolloid, sodium alginate with a concentration of 3%. Furthermore starter result of immobilization will be applied to the process of making yoghurt and the response that is testing the levels of lactic acid, pH and viscosity, to take one type of starter that will be used in the main research where in the yoghurt with acid levels that most closely with SNI yoghurt will be selected, levels lactic acid in yogurt quality requirements (SNI 01-2981-1992) is 0.5% - 2%.

Main Research

The main research was conducted to determine the type and concentration of hydrocolloid is right for planting the selected yoghurt starter. The treatment consists of two factors: type of hydrocolloid (sodium alginate, bacto agar, carrageenan) and the concentration of hydrocolloid (1%, 3%, 5%)

Experimental Design

The experimental design used was randomized block design. A randomized block design was a randomized block design is done by grouping the experimental unit into homogeneous groups called the group and then determine the treatment randomly within each group.

Response

Response to chemical, physical and organoleptic performed at four times the manufacture of yoghurt with a gap of one day, using selected starter of immobilization. Chemical response consists of lactic acid and pH. Physical response consists of viscosity. Organoleptic attribute response consisted of odor, flavor and consistency.

3. Results and Discussion

Preliminary research

The test results of the yoghurt response using different starter imobil can be seen in the following table:

Table 1. Test Results Response of Preliminary Research

Response	Starter Lab TP	Starter Columbia
Levels of lactic acid	Vtitration = 0.45 mL Lactic acid = 0.9%	Vtitration = 0.7 mL Lactic acid = 1.26%
pH	3.66	3.60
Viscosity	4 dPa.s	5 dPa.s
Total microbial	1.96×10^6	2.43×10^6

Main Research

Results of Chemical Analysis

A. Lactic Acid Levels

In fermentation 1, based on the calculation of ANOVA showed that the type of hydrocolloid (A), the concentration of hydrocolloid (B) and their interaction (AB) have no effect on levels of lactic acid in yogurt.

In fermentation 2, based on the results of Anova calculation shows that the type of hydrocolloid (A) to give effect to the levels of lactic acid in yogurt, whereas the concentration of hydrocolloid (B) and their interaction (AB) have no effect on levels of lactic acid in yogurt.

Table 2. Effect of hydrocolloid type on Lactic Acid Levels Yoghurt (Fermentation 1)

Hidrocolloid Types (A)	**Average of Lactic Acid Levels (%)**
a_2 (Bacto Agar)	1.19 % a
a_1 (Sodium Alginate)	1.36 % ab
a_3 (Carrageenan)	1.42 % b

Description: small letters on the average value of lactic acid levels, showed significantly different at 5% level.

In the fermentation 3 and 4, based on the calculation of ANOVA showed that the type of hydrocolloid (A), the concentration of hydrocolloid (B) and their interaction (AB) have no effect on levels of lactic acid in yogurt.

The procedure uses a matrix of sodium alginate immobilization is very simple and has a high success rate, although this matrix there are drawbacks, ie they can immigrate bacterial cell immobilization matrix out through the pore formed in the cell alginate with calcium ions. Bacteria that came out of the matrix will not interfere with the fermentation process (Brodieus and Vandamme, 1987).

Based on the theory in the previous paragraph that the bacterial cells are still able to immigrate out matrix immobilization, so that when the theory associated with the test results of the response levels of lactic acid fermentation to-2 in which the influence of the type of hydrocolloid used as a matrix of immobilization of the lactic acid levels produced in yogurt is because theory suggests that bacterial cells are still able to immigrate out matrix immobilization making it possible to increase the production of lactic acid in yogurt when fermented, resulting in fermentation 3rd and 4th lactic acid production decreases due to bacteria immigrate, making the bacteria caged in the matrix is reduced.

Influential at the time of the 2nd fermentation course also due to the enlargement of the immobilization matrix porosity due to the re-use after the immobilization matrix used for fermentation 1

B. pH

In each of the fermentation of the 1st to the 4th, based on the calculation of ANOVA showed that the type of hydrocolloid (A), the concentration of hydrocolloid (B) and their interaction (AB) does not give effect to the pH of the yogurt.

At pH overall (average result of all parameters of fermentation), based on the calculation of ANOVA showed that the type of hydrocolloid (A), the concentration of hydrocolloid (B) and their interaction (AB) does not give effect to the pH of the yogurt.

After calculating the experimental design use randomized block design at pH overall from an average yield ranging from fermentation to-1 to fermentation 4th, result calculation of ANOVA remains that that type of hydrocolloid (A), the concentration of hydrocolloid (B) and their interaction (AB) have no effect on pH in the yogurt, the same as if the calculation performed on each fermentation.

Increased lactic acid composition causes a decrease in pH. According Winarno et al., (2002) is a basis for making yoghurt fermentation process component sugars in the milk into lactic acid and other acids. The lactic acid produced during the fermentation process can improve the taste and increase the acidity or pH decrease.

The higher levels of lactic acid, the amount of acid in the medium will increase and decrease the pH value and vice versa. According Hartoto (2003) increasing H^+ ion content in the fermentation medium due to decomposition of metabolic acids such as lactic acid, acetaldehyde, acetic acid and other acids that cause acidity increased.

Based on the above theory, it can also be concluded that it could have been, lactic acid levels not too high but because there are other acids that instead of lactic acid can increase the acidity so that it made pH more lower, this may also explain why the lactic acid levels there are factors that influence significantly different to the levels of lactic acid, but not significantly different effect on the pH value.

Results of Phisical Analysis

Viscosity

In fermentation 1, based on the results of ANOVA calculation shows that the type of hydrocolloid (A) to give effect to the viscosity in yoghurt, whereas the concentration of hydrocolloid (B) and their interaction (AB) give no effect on the viscosity of the yoghurt.

Table 3. Effect of hydrocolloid type on Yoghurt Viscosity (Fermentation 1)

Hidrocolloid Types (A)	**Average of Viscosity (%)**
a_2 (Bacto Agar)	3.94 a
a_1 (Sodium Alginate)	4.50 ab
a_3 (Carrageenan)	5.17 b

Description: small letters on the average value of lactic acid levels, showed significantly different at 5% level.

In fermentation 2, based on the results of ANOVA calculation shows that the type of hydrocolloid (A) to give effect to the viscosity in yoghurt, whereas the concentration of hydrocolloid (B) and their interaction (AB) give no effect on the viscosity of the yoghurt.

Table 4. Effect of hydrocolloid type on Yoghurt Viscosity (Fermentation 2)

Hidrocolloid Types (A)	**Average of Viscosity (%)**
a_2 (Bacto Agar)	3.56 a
a_1 (Sodium Alginate)	3.94 ab
a_3 (Carrageenan)	4.67 b

Description: small letters on the average value of lactic acid levels, showed significantly different at 5% level.

In the fermentation of the 3rd and 4th fermentation, based on the results of ANOVA calculation shows that the type of hydrocolloid (A), the concentration of hydrocolloid (B) and their interaction (AB) give no effect on the viscosity of the yoghurt. According to Jannah (2012), using dry starter matter contained in the milk to be converted into lactic acid during the fermentation process takes place, the onset of lactic acid causes the denaturation of casein as evidenced by the formation of coagulation, which will cause changes in viscosity in yoghurt. Karinawatie, Kusnadi and Erryana, (2008) added when the milk pH below 4.6, the casein will be coagulated to form a strong structure. The more viscous a solution, the higher the viscosity.

The viscosity of the yoghurt formed from the protein content in milk is coagulated by pH. Clots casein by acid during the fermentation process is controlled from the pH value. Casein particles are at a point isoelektris at pH 4.6 at which the activities of the water particles decreases so will happen coagulated protein precipitation and viscosity will increase (Arifin, 2011).

Based on the above theory, then the theory is exactly the reason why their significantly different effect only occurs on the viscosity of the fermentation 1 and 2, because when viewed from the pH value, the fermentation 1 and 2 was produced pH that are in the range of number 3, while the fermentation 3 and 4 are in the range of number 4, in other words, because the fermentation of the 1 and 2 have a lower pH than the fermentation 3 and 4.

Results of Organoleptic

A. Odor

Based on the results of ANOVA calculations show that the types of hydrocolloid (A) to give effect to the attributes aroma in yoghurt, whereas the concentration of hydrocolloid (B) and their interaction (AB) does not give effect to the odor attributes on yogurt.

In testing the organoleptic attributes of aroma in yoghurt has an average value of 4.36 overall, where panelists responded rather like to attribute the yoghurt odor.

The odor or aroma of food delicacy often determine groceries. Aroma has more to do with the senses of smell. New scent can be recognized if the form of vapor and molecules aroma components should be touching the olfactory cilia cells. Aroma received by the nose and the brain is a mixture of four main fragrant smell, sour, rancid, and charred (Winarno, 1997)

B. Consistency

Based on the results of Anova calculations show that the types of hydrocolloid (A) to give effect to attribute consistency in yoghurt, whereas the concentration of hydrocolloid (B) and their

interaction (AB) does not give effect to the consistensy attributes on yogurt.

In testing the organoleptic attributes of consistency in yoghurt has nilsi overall average of 3.87, which the panelists responded rather not like to attribute the consistency of yogurt.

C. Flavor

Based on the results of Anova calculations show that the types of hydrocolloid (A) to give effect to the yoghurt flavor attributes, whereas the concentration of hydrocolloid (B) and their interaction (AB) does not give effect to the yoghurt flavor attributes.

Table 5. Effect of hydrocolloid type against the Yoghurt Flavor Attributes

Hidrocolloid Types (A)	**Averages**
a_2 (Bacto Agar)	1.95 a
a_1 (Sodium Alginate)	2.02 ab
a_3 (Carrageenan)	2.03 b

Description: small letters on the average value of lactic acid levels, showed significantly different at 5% level.

In testing the organoleptic attributes of taste in yoghurt has nilsi overall average of 3.45, which the panelists responded rather not like to attribute the yogurt flavors.

The flavors found in yogurt is heavily influenced by the content of lactic acid is formed. This is related to the results of pH and acidity produced. Sour flavor is influenced by the result of fermentation of lactose is converted to lactic acid by BLA. According to (Irkin and Eren 2008 in Arifin 2011) that L.bulgaricus bigger role in the formation of aroma, while the S. thermophilus bigger role in the formation of yogurt flavors. (Chandan 2006 in Arifin) adds a distinctive flavor yogurt is obtained by the formation of lactic acid, acetaldehyde, acetic acid and diacetyl.

The aroma and taste of yoghurt is influenced by the presence of certain compounds in yogurt like compound acetaldehyde, diacetyl, acetic acid and other acids are very few. These compounds are formed by bacteria Streptococcus thermophillis of lactose milk, also produced by some strains of the bacterium Lactobacillus bulgaricus (Friend et al, 1985 in Arifin, 2011).

Conclusion

Based on research results, i.e. conclusions can be drawn that the results of the preliminary study showed that the starter obtained from Columbia Store was elected starter with high levels of lactic acid produced in the yogurt was 1.26%, pH 3.60 and viscosity 5 dPa.s. The type of hydrocolloid used as a matrix immobilization for starter immobilized affect the levels of lactic acid fermentation 2, but does not affect the other parameters, the viscosity of the fermentation 1st and 2nd but has no effect on other parameters, and the attributes of taste in yoghurt , The concentration of hydrocolloid used as a matrix for the immobilization of starter immobilization give no influence on the whole the response variable is generated. The interaction between the type of hydrocolloid (A) and the concentration of hydrocolloid (B) is not striving against all response variables tested. The selected treatment is the a2b2 treatment (hydrocolloid order types and concentrations of hydrocolloid Bakto 3%) with an average content of lactic acid produced in yoghurt is 1%, pH of 3.94, and a viscosity of 4.1 dPa.s. Yoghurt in almost all variables good response from the fermentation of the 1st, 2nd, 3rd and 4th, still in the SNI standard yogurt, except in the fermentation to-2, there is one treatment that produces lactic acid 2.07%, 0.07% exceeded the maximum levels of lactic acid in yogurt SNI. In response to the pH of the fermentation 1 to fermentation 4 (overall) after the design calculations experiment with methods of RBD, based on the calculation ANOVA showed that the type of hydrocolloid (A), the concentration of hydrocolloid (B) and their interaction (AB) did not give influence on the pH of the yogurt.

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