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DIRECT AMIDATION OF FATTY ALCOHOL AND AMINO ACID IN ORGANIC SOLVENT FOR THE PRODUCTION OF N-ACYL ARGININE

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ABSTRACT

N-acyl arginine is a surfactant product based on fatty alcohol and the amino acid arginine. Direct amidation of dodecanol and arginine using organic solvents is one way to obtain N-acyl arginine. This study aimed to determine the relationship between variables to conversion, optimum reaction conditions, and the characteristics of the N-acyl arginine surfactant obtained. In this study, a preliminary study and optimization were carried out in which dodecanol, arginine, sodium methoxide, and tert-amyl alcohol were reacted to obtain the surfactant N-acyl Arginine. Optimization research is carried out by reacting the substrate with a ratio of 1:1.32; 1:2; 1:3; 1:4; and 1:4.68, catalyst with a concentration of 1.64%; 3%; 5%; 7%, and 8.36%, as well as solvents with a ratio of 1:0.32; 1:1; 1:2; 1:3; and 1: 3.68, the reaction was carried out at 70ºC for 3 hours at 350 rpm. The product will be analyzed by determining the acid number to obtain the percent conversion of N-acyl arginine, determining the saponification number to determine the value of Hydrophilic Lipophilic Balance. The optimum conversion percentage obtained was 90% under the conditions of 4:1 substrate ratio, 3% catalyst concentration, and 3:1 solvent ratio. From the surfactant N-acyl arginine analysis, the acid number is 0.561, the saponification number is 0.4207, and the HLB value is 5.00.

Keywords: arginine, dodecanol, tert-amyl alcohol, surfactants.

INTRODUCTION

The synthesis of amide compounds is a significant subject of organic chemistry. Amides have a vital role in biological systems such as proteins and peptides for derivative products such as pharmaceutical products, natural products, chemicals, and polymers. The amidation reaction is a reaction between carboxylic acids and activated carboxylic acid derivatives such as chlorides, anhydrides, esters, and acyl amides with amines [1, 2].

Carboxylic amides are among the most essential and ubiquitous organic functional groups for natural products, both peptides, and no pesticides, pharmaceuticals, agrochemicals, and polymers. The amide functional group's idiosyncratic properties are evident, for example, from their presence in about 25% of the drugs available. Most of the amide bond formations use an amine reaction in the presence of a stirring agent, such as acyl chloride, or the reaction of carboxylic acids with amines in a coupling agent [2, 3].

Surfactants have been made using fatty acids, methyl esters, lignin, and hexadecanol. In applications, the use of fatty alcohol with the number of groups 12 is also used dodecanol [4-7]. Dodecanol is a type of amphiphilic fat which is often used as an emulsifier. Dodecanol has a melting point of 24 ºC and a boiling point of 259 ºC [8].

The potential of amino acid-based surfactants in bulk detergents for industrial and household cleaning uses is highly dependent on the use of cheap and renewable raw materials (such as amino acids and fatty acids) with the rapid and complete biodegradability expected in the environment [9, 10]. Amino acids are an alternative ingredient in surfactants. Amino acid-based surfactants are widely used in various applications [11].

The preparation of surfactants has been carried out using amine lysine, histidine, and tryptophan [5, 12]. In surfactant manufacturing applications, arginine-based amino acids can be used. Arginine-based surfactants are amphiphilic compounds with excellent self-assembling properties, low toxicity profiles, high biodegradability, and broad antimicrobial activity [13, 14].

The preparation of surfactants can be done using KOH catalysts and NaOH. Common alkaline homogeneous catalysts include sodium hydroxide (NaOH), potassium hydroxide (KOH), sodium methoxide (CH_3ONa), and potassium methoxide. In this case, the surfactant preparation using a sodium methoxide (CH_3ONa) catalyst can be used. Sodium methoxide catalyst can catalyze reactions under low-temperature conditions and atmospheric pressure and obtain high conversion in minimum time. Therefore, the essential homogeneous catalyst, namely CH_3ONa, is the most effective. Sodium methoxide is an active catalyst that can produce the highest yield of> 99% under mild reaction conditions [3, 6].

This study used tert-amyl alcohol as a solvent. According to the observations before on the synthesis of alkanol amide, research was carried out with four different types of solvents: n-hexane, isopropanol, tert-butanol tert-amyl alcohol. The use of tert-amyl alcohol has several advantages, including lower tert-amyl alcohol toxicity and tert-amyl alcohol are inert, so it does not reduce the product mixture, and the tert-amyl alcohol solvent is a non-solvent that is polar [16].

Reaction control is needed to optimize the synthesis of a process. One of the efforts to control the reaction is to study the interaction of research variables with the Response Surface Methodology (RSM) [17, 18]. RSM is a combination of mathematical and statistical techniques used in the variable analysis, formulation of mathematical models, and prediction of optimal responses. The RSM method is used to determine suitable conditions for the amidation reaction and obtain the maximum conversion of fatty acids and their amides [3, 19].

Surfactants are not only related to soap and detergents in daily life, but they are also indispensable for industrial processes that require colloid stability, metal treatment, mineral flotation, pesticides, oil production, pharmaceutical formulations, emulsion polymerization, and particle growth. Surfactants are also used in everyday life: food, medicine, toiletries, cleaners, automotive fluids, paints, and coatings. Surfactants can also be used as a solubilizing agent, wetting agent, and emulsifier [10, 12, 14].

Based on the theory that has been described, it is necessary to research the synthesis of the surfactant N-acyl Arginine from Fatty Alcohol using a catalyst of sodium methoxide and tert-amyl alcohol as a solvent. Amino acid-based surfactants such as arginine are advantageous for pharmaceutical and hemolytic applications [4, 12]. Arginine is an essential amino acid having the molecular formula $C_6H_{14}N_4O_2$, molecular weight 174.2 g/mol. Arginine is a primary amino acid that is positively charged at physiological pH.

MATERIALS AND METHODS

Materials

The materials used are arginine ($C_6H_{14}N_4O_2$), dodecanol ($C_{12}H_{26}O$), sodium methoxide (CH_3ONa), tert-amyl alcohol, citric acid, acetone, 2-propanol, potassium hydroxide (KOH), hydrochloric acid (HCl), and phenolphthalein. All of them were obtained from E. Merck Darmstadt, Germany.

Effect of Reaction Time

The determination of the reaction time begins by determining the initial acid number of dodecanol. Furthermore, 3 g of dodecanol was added to the three-neck flask, tert-amyl alcohol was added, with a solvent: substrate ratio (v/w) 2:1, arginine with a dodecanol to arginine ratio of 1:3 into the beaker glass. Sodium methoxide (CH_3ONa) catalyst was added with a weight percentage of 5% to dodecanol and reacted for 3, 4, and 5 hours. Sampling was carried out at 3, 4, and 5 hours then titrated with KOH to test the final acid number. From the acid number data, the percent conversion can be calculated.

Optimization Research

Using a hot plate equipped with a magnetic stirrer, an amount of 5 g of dodecanol is put into a three-neck flask. To a glass beaker is added tert-amyl alcohol with a substrate to solvent ratio (w/v) 1:0.32; 1:1; 1:2; 1:3; and 1:3.68. Arginine is mixed with a solvent in a beaker glass with a variation of the ratio of dodecanol to arginine 1:1.32; 1:2; 1:3; 1:4; and 1:4.68. The solvent and substrate mixture is then put into a three-neck flask, and sodium methoxide catalyst is added with a weight percent ratio of 1.64%; 3%; 5%; 7%; and 8.36% against dodecanol.

It was heated with the best temperature and heating time from the determination of reaction time. The mixture was separated from the catalyst by adding 10% citric acid and filtered. The product mixed with the solvent was separated by evaporating the solvent at 101^{o}C. The excess arginine in the product is then washed with acetone twice the volume of the product mixture. The excess acetone was evaporated, and the acid number and saponification number were tested on the N-acyl Arginine surfactant obtained. Percent conversion is calculated.

Acid Number and Saponification Number Analysis

The acid number determination refers to the American Standard Testing and Materials, ASTM D664 Standard Test Method [20]. The saponification number determination refers to America Standard Testing and Material, ASTM D5558 Standard Test Method [21].

Table-1. Variables and levels of the CCD model and conversion results of the surfactant N-acyl arginine.

Run	Temp. (°C)	Time (h)	Mol of substrate, X_1 (dodecanol/arginine)	Percent of catalyst, X_2 (w/$w_{dodecanol}$)	Ratio of solvent, X_3 (mL/$mL_{dodecanol}$)	Conversion, Y (%)
1	70	3	-1 (1/2)	-1 (3)	-1 (1/1)	72.5
2	70	3	1 (1/4)	-1 (3)	-1 (1/1)	87.5
3	70	3	-1 (1/2)	1 (7)	-1 (1/1)	80.0
4	70	3	1 (1/4)	1 (7)	-1 (1/1)	90.0
5	70	3	-1 (1/2)	-1 (3)	1 (1/3)	80.0
6	70	3	1 (1/4)	-1 (3)	1 (1/3)	87.5
7	70	3	-1 (1/2)	1 (7)	1 (1/3)	80.0
8	70	3	1 (1/4)	1 (7)	1 (1/3)	85.0
9	70	3	-1.682(1/1.32)	0 (5)	0 (1/1)	70.0
10	70	3	1.682 (1/4.68)	0 (5)	0 (1/2)	82.5
11	70	3	0 (1/3)	-1.682 (1.64)	0 (1/2)	85.0
12	70	3	0 (1/3)	1.682 (8.36)	0 (1/2)	87.5
13	70	3	0 (1/3)	0 (5)	-1.682 (0.32/)	85.0
14	70	3	0 (1/3)	0 (5)	1.682 (8,36)	85.0
15	70	3	0 (1/3)	0 (5)	0 (5)	85.0
16	70	3	0 (1/3)	0 (5)	0 (5)	87.5
17	70	3	0 (1/3)	0 (5)	0 (5)	87.5
18	70	3	0 (1/3)	0 (5)	0 (5)	85.0
19	70	3	0 (1/3)	0 (5)	0 (5)	87.5
20	70	3	0 (1/3)	0 (5)	0 (5)	85.0

Optimization Process

There are three variations of the variables selected to obtain the surfactant N-acyl arginine in this study: substrate ratio, catalyst concentration, and solvent ratio. X_1 denotes the substrate mole ratio, the catalyst weight is denoted by X_2, and X_3 denotes the solvent ratio. Using the CCD model variable and level, the conversion results of the surfactant N-acyl arginine were obtained as in Table-1. From the research data obtained in the 20 experiments, the analysis was then carried out using the Response Surface Methodology. Process optimization involves estimating coefficients, predicting responses, and checking the acceptance of the developed model.

RESULTS AND DISCUSSIONS

Effect of Reaction Time

To determine the reaction time used as a fixed variable in the CCD design study, the conversion changes were observed at each change in reaction time with other conditions fixed. This research was conducted by reacting dodecanol and arginine with tert-amyl alcohol and sodium methoxide as a catalyst. The best reaction time can be seen based on the conversion obtained. The conversion can be calculated based on the acid number obtained at each sampling hour, namely the three h, four h, and five h.

Figure-1 illustrates the relationship between reaction time and dodecanol conversion (Y-Data) on motor rotation and temperature changes. In general, it is illustrated that Y-Data will decrease with each increase in reaction time. This is probably due to the increasing reaction time of water, where the water formed reacts with the ester. The reaction time played a role in controlling the amide recovery, where after a specific reaction time; the ester formed would become amide-esters because the acyl donor would bind to the N atom in the ester [16].

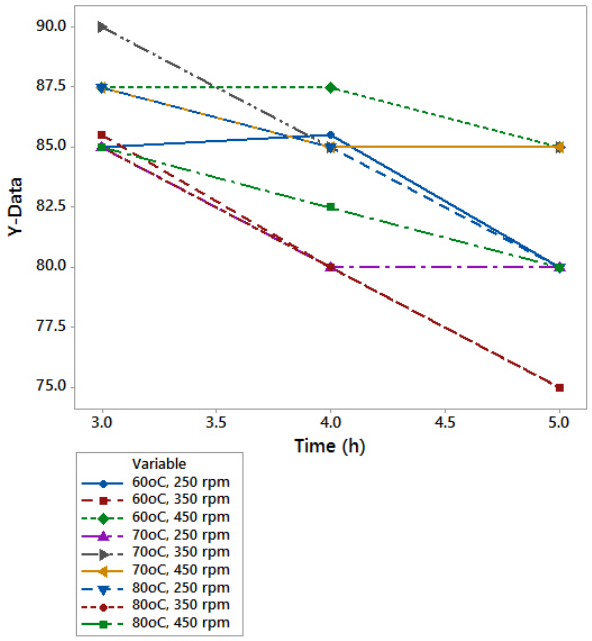

Figure-1. The effect of reaction time on dodecanol conversion (Y-Data).

It can be seen that the highest conversion is obtained at a reaction time of 3 hours, with a temperature of 70°C, and stirring rotation of 350 rpm. Based on the results of these data, the conversion of dodecanol obtained is 90%.

Optimization Results

Below you can see the p-value for the mol of the substrate (X_1), percent of catalyst (X_2), and the ratio of solvent (X_3). Based on Table 2, the p-value for the mol of a substrate, percent of catalyst, and the solvent ratio is 0.000, respectively; 0.026; and 0.589. The mol of substrate and percent of catalyst have a P-value less than α (5%), while the solvent ratio has a P-value more significant than α (5%). Based on the p-value, it can be seen that the mol of substrate and percent of catalyst are statistically significant factors that affect the percent conversion of surfactant N-acyl Arginine synthesis because it has a P-value of less than 5%.

In addition to the p-value obtained by using the MINITAB 17 trial version software, there is also an equation model that is useful for showing the relationship of reaction variables and their interactions with the percent conversion, where the modeling can be used to find the conversion value of the model. Based on the research conducted, it was obtained regression equation in uncoded units

Conversion = 86.233 + 4.285 Mol of substrate
+ 0.857 Percent of catalyst
+ 0.183 Ratio of solvent
- 3.422 Mol of substrate*Mol of substrate
+ 0.114 Percent of catalyst*Percent of catalyst
- 0.328 Ratio of solvent*Ratio of solvent
- 0.938 Mol of substrate*Percent of catalyst
- 1.563 Mol of substrate*Ratio of solvent
- 1.563 Percent of catalyst*Ratio of solvent

There are negative and positive signs in the equation above, where the positive sign shows an enormous influence on% conversion compared to other experimental variables. In contrast, the negative sign in the equation shows an inversely proportional relationship with a positive sign on% conversion [16]. The coefficient X1 value in the equation is the most considerable coefficient value, which is 4.285, which means that the coefficient X1 has the most significant effect on the% conversion of N-acyl Arginine surfactant.

The coefficient of determination (R^2) from the analysis results of 97.03% indicates that the experiment's independent variable affects the dependent variable (% conversion) of 97.03%.

Mol of Substrate and Percent of the Catalyst

Table-2 shows that the mol of substrate and percent of catalyst have a significant effect on the conversion of dodecanol to N-acyl arginine in the regression model compilation stage. The single effect and the squared effect of the substrate's mol are highly significant, with a p-value of 0.000. However, the interaction effect of the mol of substrate and percent of the catalyst was not significant in product formation, namely 0.053.

Table-2. The regression model development stage.

Term	Effect	Coefficient	SE Coef	T-Value	P-Value	VIF
Constant		**86.233**	**0.494**	**174.61**	**0.000**	
Mol of substrate (X_1)	14.414	7.207	0.551	13.08	0.000	1.00
Percent of catalyst (X_3)	2.883	1.441	0.551	2.62	0.026	1.00
Ratio of solvent (X_2)	0.616	0.308	0.551	0.56	0.589	1.00
X_1*X_1	-19.355	-9.678	0.902	-10.73	0.000	1.02
X_2*X_2	0.645	0.322	0.902	0.36	0.728	1.02
X_3*X_3	-1.855	-0.928	0.902	-1.03	0.328	1.02
X_1*X_2	-5.300	-2.65	1.210	-2.19	0.053	1.00
X_1*X_3	-8.840	-4.42	1.210	-3.65	0.004	1.00
X_2*X_3	-8.840	-4.42	1.210	-3.65	0.004	1.00

Figure-2 shows a contour plot of the interaction of the substrate's mole and percent of catalyst on the response to dodecanol conversion. It can be seen that when the mol of the substrate is constant and the ratio of solvent is maintained at a hold value of 0, increasing the percent of catalyst will slightly reduce surfactant gain. This is in line with the regression equation obtained, namely that the interaction between the two is -2.65. However, in general, increasing the mol of the substrate in the ratio of solvent is kept at point 0, will increase the dodecanol conversion, and the maximum conversion is obtained in the mole area of substrate 0 - 1, and the percent of catalyst 1-1.5. In this condition, the dodecanol conversion is more than 88%.

The interaction of a mole of substrate and percent of catalyst on dodecanol conversion was also observed at a fixed ratio of the solvent of 1.682, as shown in Figure-3. At the maximum value of the ratio of solvent, it was observed that an increase in the value of the two variables had little effect on the increase in conversion. When the substrate mole is more than 1, increasing the catalyst's percent decreases the conversion slightly. The maximum dodecanol conversion value is obtained at the mol of the substrate value of 0-1.0 and the minimum percent of catalyst, namely -1.5 to -1. In this condition, the conversion of dodecanol to N-acyl arginine reaches 88%. So it can be concluded that the use of a ratio of solvent 1.682 can be considered because it will get the maximum conversion at the minimum percent of catalyst value and average mol of the substrate [3].

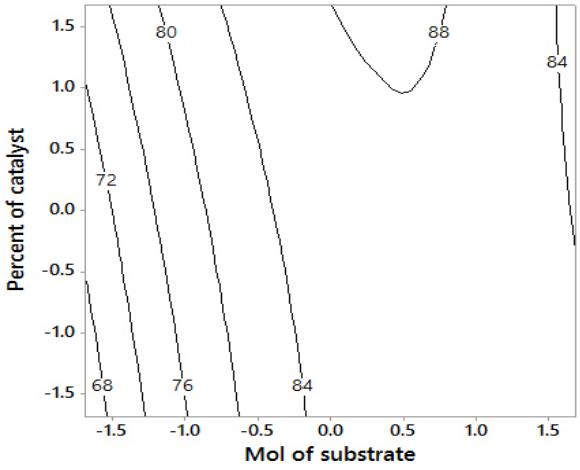

Figure-2. Contour plot of the interaction of the substrate's mole and the catalyst at the solvent's hold value ratio is equal to 0.

Figure-4 shows the interaction of the mol of substrate and percent of catalyst on dodecanol conversion. This contour plot was observed at a fixed ratio of the solvent of -1,682. The use of the solvent ratio at the minimum value does not appear to result in the maximum conversion of dodecanol.

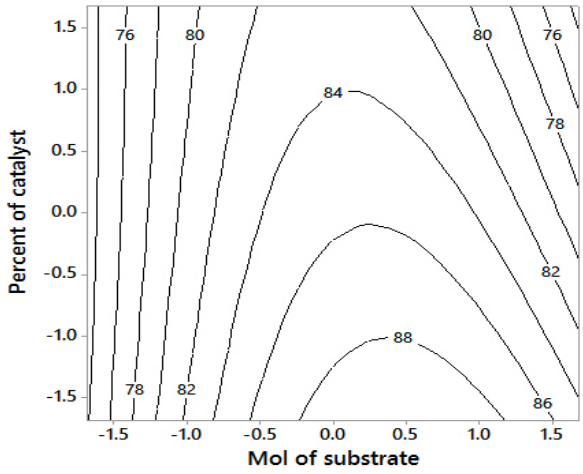

Figure-3. Contour plot of the interaction of the mole of substrate and percent of catalyst at the hold value ratio of solvent equal to 1.682.

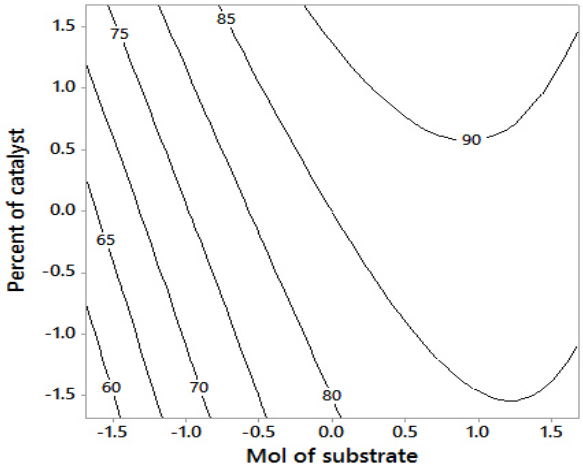

Figure-4. Contour plot of the interaction of the mole of substrate and percent of catalyst at the hold value ratio of solvent equal to -1.682.

It appears that the increase in the percent of catalysts in the mol of the substrate will still result in smaller converted dodecanol compared to the same conditions at a larger ratio of solvent. So that the ratio of solvent -1.682 is not appropriate for this reaction. When using the minimum ratio of solvent, the best results are to use the maximum percent of catalyst and mol of the substrate.

The conversion of fatty alcohols and fatty acids is influenced by the carbon chain's length at the hydrophobic, hydrophilic, and concentration ends. However, the hydrophobic end carbon chain's length has a more significant impact than the length of the hydrophilic end [2]. Fatty acid conversion will also increase with increasing substrate molar ratio [3]. Surfactant production depends on the composition and concentration of the substrate. Higher concentrations will lead to an increase in the product obtained [5].

Mol of Substrate and Ratio of Solvent

In Figure-5, the relationship between the mol of the substrate and the ratio of solvent to conversion, where it can be seen that the resulting conversion tends to increase. The observation on the hold value of 0 percent of catalyst shows that increasing the solvent ratio in the mol of the substrate will still result in a constant conversion of dodecanol. The dodecanol conversion will increase, and the maximum in the mol of substrate range 0.5-1.5 and the ratio of solvent -1.5 - 0.5. The interaction of mole of the substrate with the ratio of solvent to conversion at hold value percent of catalyst 1.682 is given in Figure 6. As the trend in Figure-5, at a minimum and constant mole of the substrate, increasing the solvent ratio does not appear to increase the amount of dodecanol converted to the product. It was also found that the conversion decreased with decreasing solvent ratio at maximum moles of the substrate, and maximum conversion resulted in moles of substrate 0.5-1. The product value or yield will be high when the solvent ratio increases, and the solvent to oil / fat ratio higher than 1/1 have better heat stability [1].

In the -1.682 percent of catalyst, as they hold value, the interaction between the mol of the substrate and the ratio of solvent on fatty alcohol conversion was also observed. The contour plot in Figure-7 shows the results obtained, where at the minimum amount of catalyst, the comprehensive range of observations of the other two variables, the conversion gain is smaller than using a catalyst at the center point maximum. This observation's best result is the ratio of solvent and maximum substrate mol, which is> 86%. This is since the amount of catalyst -1.682 is still insufficient to be used with the existing substrate, so that the conversion obtained is not optimal.

Percent of Catalyst and Ratio of Solvent

Figure-8 shows the relationship between the percent of catalyst and the ratio of solvent with the conversion where the resulting contour resembles a horse saddle. The minimum value of the conversion is when the interaction between the percent of catalyst and the solvent ratio is at the minimum and the maximum value. However, in a moderate range, the dodecanol conversion will increase, and the best conversion of this contour is seen at the maximum percent of catalyst and a minimum ratio of solvent.

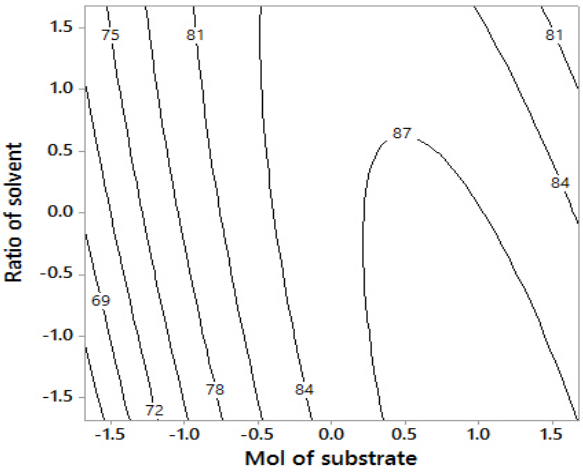

Figure-5. Contour plot of the interaction of the substrate's mole and the ratio of solvent at the hold value the percent of catalyst equal to 0.

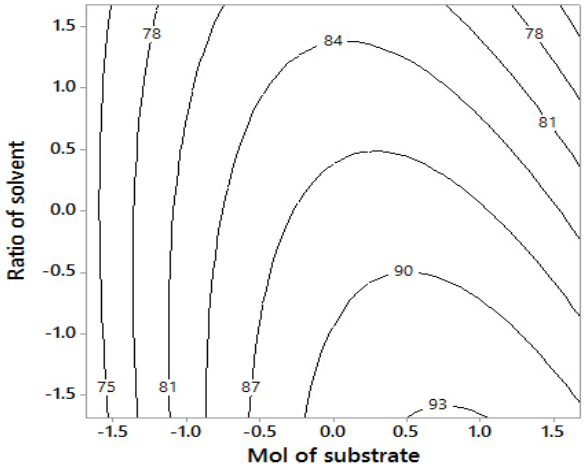

Figure-6. Contour plot of the interaction of the substrate's mole and the ratio of solvent at the hold value the percent of catalyst equal to +1.682.

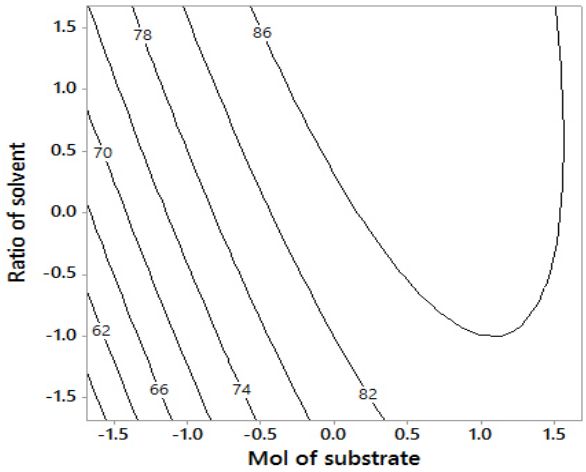

Figure-7. Contour plot of the interaction of the substrate's mole and the ratio of solvent at the hold value the percent of catalyst equal to -1.682.

So it can be concluded that if the mol of the substrate is used as a hold value at 0 (center point), the pattern is formed is like a horse saddle with up to 90% conversion.

The contour plot in Figure-9 shows the interaction on the hold value of mol of substrate 1.682. At the maximum value of the substrate's mol, the contour area that produces the maximum conversion is when the percent of catalyst is maximum, and the ratio of solvent is from minimum to moderate. If the substrate's mole is maximum, if the ratio of solvent and percent of catalyst is also maximum, the interaction between the two will decrease the dodecanol conversion by up to 75%. So that the RSM used is very useful in knowing that precisely at the maximum interaction value, the conversion of dodecanol will be minimum.

However, if the substrate's mol as a hold value and a minimum value, the opposite will be observed, as shown in Figure 10. Through this contour plot, it can be seen, as usual, namely by increasing the percent of catalyst and ratio of solvent, the interaction both of them will also increase the conversion of dodecanol to the surfactant N-acyl arginine.

The catalyst used to synthesize the surfactant N-acyl Arginine is sodium methoxide, where sodium methoxide is a very active catalyst to produce high yields under mild reaction conditions [9]. The increase in product yield was observed to increase with increasing the chain length of the alkyl surfactant. Catalyst concentration is a significant factor that exclusively affects product yield, where the yield increases with increasing catalyst concentration, and the reaction runs more effectively [13].

Main Effect and Interaction Plot

The main effect and interaction effect between dodecanol conversion variables can also be summarized in Figures 11 and 12. The plots' main effects for conversion for the mol of the substrate, percent of catalyst, and the solvent ratio are shown in Figure-11. The mol of substrate

plot shows that the conversion increases from mol of substrate -1.682 to 1. After mol of substrate 1, the conversion trend will decrease to mol of substrate 1.682, and the best average conversion is around 87% with mol of substrate 1.

For the plot of the percent of catalyst, the trend shows that the average conversion will increase linearly as the catalyst increases, and the maximum conversion will be obtained at 1.682 percent of catalyst. The maximum average conversion is also around 87%.

To plot the ratio of solvent, a sloping and linear trend is produced so that among the three variables, it can be seen that the ratio of solvent is an important variable but does not have an effect on the increase in conversion. In the overall ratio of the solvent range, the average conversion is 86%.

The interaction plot for the three variables with the average conversion is shown in Figure-12. For the interaction of the mol of the substrate and the percent of catalyst, it is found that the average conversion increases quadratically as the values of the two variables increase. The maximum average conversions are in the mol of substrate and percent of catalyst variables between 1-1.682. In the interaction between the mol of the substrate and the solvent ratio, a quadratic relationship was also observed between the two variables with the average conversion.

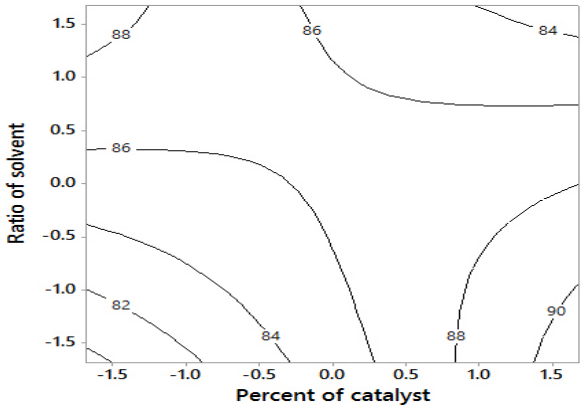

Figure-8. Contour plot of the interaction of catalyst and ratio of solvent on the hold value of mol of the substrate is equal to 0.

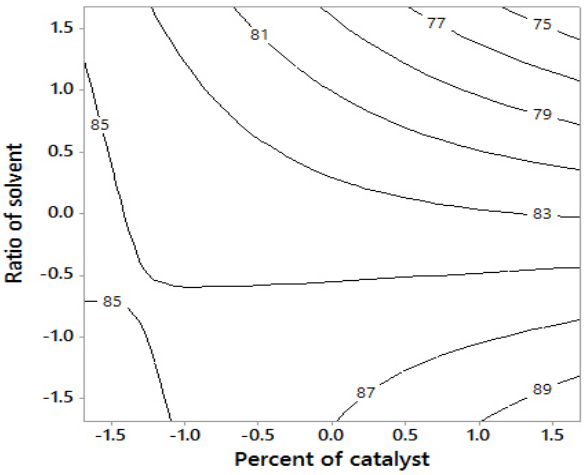

Figure-9. Contour plot of the interaction of catalyst and ratio of solvent on the hold value of mol of the substrate is equal to 1.682.

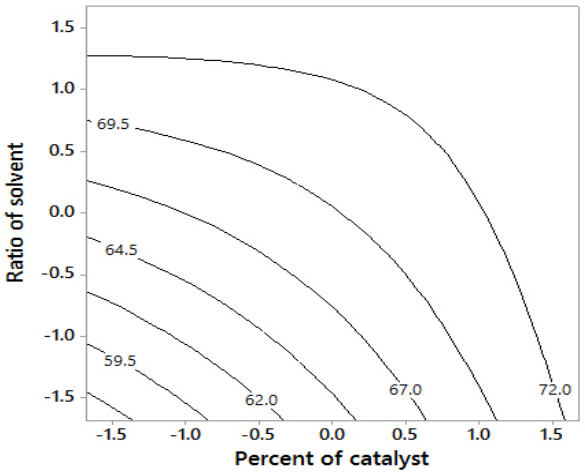

Figure-10. Contour plot of the interaction of catalyst and ratio of solvent on the hold value of mol of the substrate is equal to -1.682.

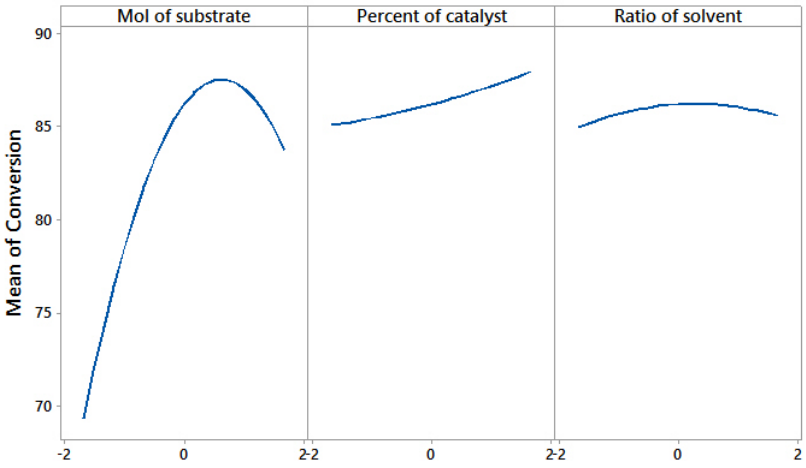

Figure-11. Main effects plot for conversion for mol of substrate, percent of catalyst, and ratio of solvent.

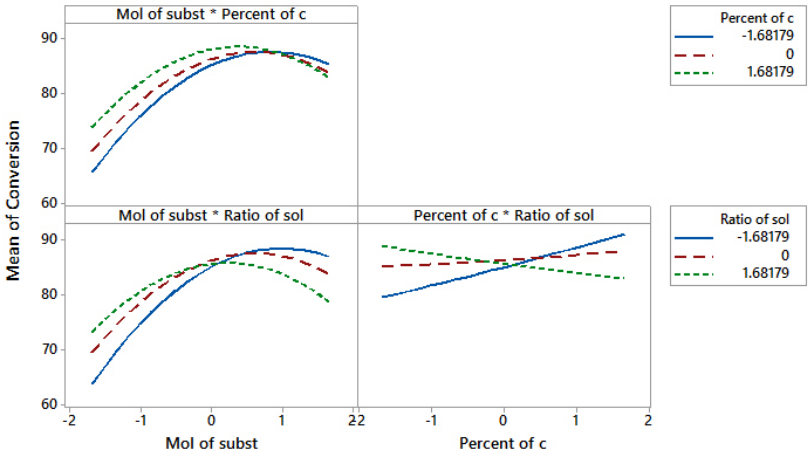

Figure-12. Interaction plots for the three variables with the mean of conversion.

However, the highest average conversion was obtained at the minimum ratio of solvent, namely -1.682, and the substrate's maximum mol, namely, 1.682. A high ratio of solvent will reduce the conversion of dodecanol to N-acyl arginine.

The interaction of the percent of the catalyst with the solvent ratio will result in a linear trend towards average conversion. For a maximum ratio of a solvent of 1,682, increasing the percent of catalyst will result in a minimum average conversion. For the solvent ratio at point 0, the use of minimum to maximum catalyst hardly gives a change in the average conversion.

SURFACTANT CHARACTERISTICS ANALYSIS

Acid Numbers

Their acid number characterizes the quality characteristics of oils and fats. The acid number is the milligram of KOH needed to neutralize the fatty acids in 1 gram of oil. A high acid number will affect the polarity and foam, thereby reducing the final product. Based on the study results, the acid number of the best N-acyl arginine surfactant was 0.561.

Saponification Numbers

The saponification number represents all the fatty acids present in the sample and is usually determined by reference. The amount of saponification number depends on the molecular weight and percentage concentration of the fatty acid components present in the oil. Based on the research results, it was obtained the saponification number of the surfactant N-acyl Arginine of 0.4207.

Hydrophile-Lipophile Balance

The HLB value of the resulting product is determined from the saponification number along with the acid number. HLB can be used to determine the solubility of surfactants in water, which can usually be used as a guide in approaching the hydrophilic-lipophilic balance and its usefulness. The HLB system is beneficial for differentiating surfactants according to their application. Based on research that has been carried out, the HLB

values obtained in the N-acyl Arginine surfactant are in the range 1-5, where when viewed from the solubility in water, the resulting N-acyl Arginine surfactant can be used as a defoaming agent and emulsifier.

CONCLUSIONS

Preliminary studies have shown that at a temperature of 70^{o}C and a reaction time of 3 hours, a dodecanol conversion of 90% will be obtained. Meanwhile, optimizing the amidation process using Central Composite Design will produce the best dodecanol conversion at a substrate 1:4 (D/A), 1:3 solvent ratio, and 3% catalyst percent. The model prediction obtained shows that the ratio of the substrate, solvent, and catalyst has a significant effect on the conversion of dodecanol to N-acyl arginine surfactant, and based on the analysis of variations, the results are following the model, namely p-value (0.728)> α (0.05). The N-acyl arginine surfactant characteristics have an acid number of 0.561, a saponification number of 0.4207, an HLB of 5. Based on these characteristics, the N-acyl arginine surfactant has minimal solubility in water and is used as an emulsifier.

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