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DEVELOPMENT OF METHYL ESTER USING BATCH ENZYMATIC REACTION

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ABSTRACT

The objective of this research is to determine the production of methyl ester by using several combination of batch processes. In the study, palm olein and methanol were utilized as a substrates and lipase enzyme as a catalyst. The result showed that the composition of 30% methanol and 70% palm olein gave the highest composition of methyl ester.

INTRODUCTION

Oleochemical industries converts naturally occuring oils and fats into products which serve a wide range of human needs. The application of biotechnology may enable some oleochemical products being synthesized under more favorable conditions, and therefore seems to be an attractive dawn of a new age in the history of oleochemical industries. Lipase is an enzyme capable of producing a variety of valuable chemicals from palm oil including methyl ester. The area of application of these oleochemical products comprises both edible and non-edible purposes such as detergents, foam booster, thickening agent and etc. One of the advantages of utilizing methyl ester is that it can avoid environmental problem for example in petroleum drilling in Malaysia. Normally Malaysia imports mineral oil as a drilling fluid, which is very expensive and could threat the environment. In the light of growing concern in for environment, an alternative solution for the problem, is by using methyl ester as a drilling fluid (M.N. Kamal et al, 1990). The major advantages of methyl ester over mineral oil include :

(i) It is biodegradable
(ii) It has lower degree of toxicity.
(iii) It is cheaper than mineral oil and locally available.

EXPERIMENTAL SET UP AND PROCEDURE

The scope of the research includes :

(1) Analyzing the composition using methyl ester standard.
(2) Choosing the best substract composition for yielding high concentration of methyl ester.
(3) Identification and analyzing of methyl ester product by using gas chromatography.

During the work, only palm olein and methanol were used as a substract and lipase enzyme as a catalyst. The experiments were run with the following equipments:

(a) Erlenmeyer flask 200 cm^3.
(b) Water bath to maintain the temperature at 60°C. The waterbath incorporate the feature such as shaker.
(c) Palm olein and methanol for the reaction and lipase as a catalyst.
(d) Methyl ester standard.
(e) Gas Chromatography to analyze the samples.

Due to the fact that methanol and palm olein is very difficult to homogenize, it is essential for the reactant to be placed in the shaker, to create a bigger surface interaction. Thus, this will expedite the reaction.

To run the experiment , put both reactants plus enzyme in Erlenmeyer Flask and shake it in water bath with a temperature of 60°C. The experiments were run at atmospheric pressure. After five hours the content of the methyl ester was analyzed by using gas chromatography. Two types of experiments has been done for the production of methyl ester:

THE CONFIGURATION OF SUBTRACT COMPOSITION:

To choose the best configuration of subtract composition in yeilding highest methyl ester production three type of batch compositions of reactant has been used:

(i) 10% methanol and 90% of palm olein.
(ii) 30% methanol and 70% of palm olein.
(iii) 50% methanol and 50% of palm olein.

TESTING THE PRODUCTION OF METHYL ESTER WITH TIME:

In this experiment the substrate composition of 30% methanol and 70% palm olein was utilized. Every two hours the samples were taken and analyzed with gas chromatography to see the content of methyl ester production.

RESULTS

(1) <u>Analyzing the composition of methyl ester standard.</u>

From the graph obtained by using gas chromatography, the composition of component in the methyl ester standard can be calculated and summarized in Table

1. These values were used as standard references for calculating the percentage conversion of methyl ester for the samples analyzed subsequently.

(2) Choosing the best substrate composition for yielding high concentration of methyl ester.

The results of different composition of substrate are shown in Tables 2-4 . Looking at retention time and comparing with the standard methyl ester, it has been found that the substrate with the composition of 30% methanol and 70% palm olein gave the best percentage of conversion as shown in Figure 3. So, the substrate with this composition was chosen to be used for testing the production of methyl ester with time.

(3) Testing the production of methyl ester with time

Referring to the retention time for the different component of substrate and comparing with the analysis of standard methyl ester, it was found that percentage of conversion of methyl ester increases with time. It increases from 1.99% when the experiment was run for 2 hours to 17.54% for 8 hours operations. But the percentage of conversion is quite low as shown in Figure 4. The results are shown in Tables 5-8.

DISCUSSION AND CONCLUSION

The batch process has been found to be not very effective in producing methyl ester because lipase enzyme is very small and can move freely during mixing and heating. Thus, it took a long time for the esterification process to be completed because of the catalyst surface is not very stable. Another reason is that the different of physical properties between methanol and palm olein such as viscosity, make it difficult for the mixing process. Probably the rate of shaking at 200 rpm in not enough to give the good mixing. The percentage of conversion was quite low, increases from 1.99% when the experiment was run for 2 hours to 17.54% for 8 hour operations. The choice of substrate composition of 30% methanol and 70% palm olein may not be correct. So, for future research more ranges of methanol composition ranging from 10% to 50% should be experimented (2).

REFERENCES

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Table 1 : Percentage of components in standard methyl ester

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.06	C12	100378	0.67
1.58	C14	203185	1.37
2.72	C16	7277152	48.84
4.84	C18	7319235	49.12
Total			100.00

Table 2 : Percentage of conversion of methyl ester for sample 1 (10% methanol and 90% palm olein)

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.56	C14	45935	22.6
2.55	C16	377405	5.2
4.49	C18	439121	6.0
Total		862461	

Table 3 : Percentage of conversion of methyl ester for sample 2 (30% methanol and 70% palm olein)

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.06	C12	34870	34.7
1.57	C14	26149	12.9
2.59	C16	601485	8.3
4.56	C18	624446	8.5
Total		12866950	

Table 4 : Percentage of conversion of methyl ester for sample 3 (50% methanol and 50% palm olein)

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.06	C12	4887	4.9
1.57	C14	9168	4.5
2.56	C16	358414	4.9
4.49	C18	347283	4.7
Total		719732	

Table 5 : Percentage of conversion of methyl ester for sample 4 (30% methanol and 70% palm olein)

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.56	C14	8806	4.3
2.57	C16	55452	0.76
4.50	C18	233392	3.2
Total		297650	

Table 6 : Percentage of conversion of methyl ester for sample 5 (30% methanol and 70% palm olein)

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.57	C14	12742	6.3
2.59	C16	171145	2.4
4.57	C18	336929	4.6
Total		520886	

Table 7 : Percentage of conversion of methyl ester for sample 6 (30% methanol and 70% palm olein)

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.07	C12	28330	28.2
1.59	C14	29409	14.5
2.62	C16	659521	9.1
4.63	C18	989957	13.5
Total		1707217	

Table 8: Percentage of conversion of methyl ester for sample 7 (30% methanol and 70% palm olein)

Retention Time (Minutes)	Carbon Component	Area	Percentage (%)
1.03	C12	30714	30.6
1.56	C14	37228	18.3
2.58	C16	1171923	16.1
4.55	C18	1374071	18.8
Total		2613936	