TÀI LIỆU THAM KHẢO

A Deen, R. V., D Wickramarachchi, N Marikkar, S Nammi, BC Jayawardana…. (2021). Chemical Composition and Health Benefits of Coconut oil: An Overview *Journal of the Science of Food and Agriculture*, 2182-2193.

André José Fernandes, E. H. (2021). Sustainable Enzymatic Approach for the Production of Essential Fatty Acid Based on Coffee Oil Hydrolysis, 152, 452–459.

Emmanuel Onoja, S. C., Fazira Ilyana Abdul Razak, Roswanira Abdul Wahab. (2018). Enzymatic synthesis of butyl butyrate by Candida rugosa lipase supported on magnetized-nanosilica from oil palm leaves: Process optimization, kinetic and thermodynamic study. *Journal of the Taiwan Institute of Chemical Engineers*, 105-118 .

Evelien Vanleeuw, S. W., Karin Thevissen, Bert Lagrain, Michiel Dusselier. (2019). Substrate-Specificity of Candida rugosa Lipase and Its Industrial Application. *ACS Sustainable Chem. Eng*, 15828–15844.

Felix Melcher, F. V., Martina Haack, Mahmoud Masri, Marion Ringel, Arne Roth, Daniel Garbe, Thomas Brück. (2023). Lipase-mediated plant oil hydrolysis—Toward a quantitative glycerol recovery for the synthesis of pure allyl alcohol and acrylonitrile. *Fats and Oils as Renewable Feedstock for the Chemical Industry*.

Freitas, L., Bueno, T., Perez, V. H., Santos, J. C., & de Castro, H. F. (2007). Enzymatic hydrolysis of soybean oil using lipase from different sources to yield concentrated of polyunsaturated fatty acids. *World Journal of Microbiology and Biotechnology*, 23, 1725-1731.

Ghoson M. Daba, F. A. M. W. A. E. (2021). The ancient koji mold (Aspergillus oryzae) as a modern biotechnological tool. *Bioresources and Bioprocessing*

Goswami, D., Basu, J. K., & De, S. (2009). Optimization of process variables in castor oil hydrolysis by Candida rugosa lipase with buffer as dispersion medium. *Biotechnology and Bioprocess Engineering*, 14, 220-224.

Hoang Chinh Nguyen, M. L. N., Phung Thanh Tran. (2018). Liquid lipase-catalyzed hydrolysis of gac oil for fatty acid production: Optimization using response surface methodology, 1129-1136.

Jian-yong Zheng, X. L., Xiao-jun Li , Li-juan Huang , Yin-jun Zhang , Zhao Wang. (2019). High-level expression and characterization of a stereoselective lipase from Aspergillus oryzae in Pichia pastoris. *Protein Expression and Purification*, 1-7.

Jun Zhang, M. T. (2020). High-efficiency expression of the thermophilic lipase from Geobacillus thermocatenulatus in Escherichia coli and its application in the enzymatic hydrolysis of rapeseed oil, .

Kim, K. H., Kwon, D. Y., & Rhee, J. S. (1984). Effects of organic solvents on lipase for fat splitting. *Lipids*, *19*(12), 975-977.

Matheus M. Ferreira, G. F. (2019). Optimization of free fatty acid production by enzymatic hydrolysis of vegetable oils using a non-commercial lipase from Geotrichum candidum. *Bioprocess and Biosystems Engineering* 42, 1647–1659.

Morenike A. Peters, C. T. A., Jiawei Wang, and Jude A. Onwudili. (2022). Subcritical Water Hydrolysis of Fresh and Waste Cooking Oils to Fatty Acids Followed by Esterification to Fatty Acid Methyl Esters: Detailed Characterization of Feedstocks and Products. *Published by American Chemical Society*, 46870–46883.

Rathod, V. K., & Pandit, A. B. (2009). Effect of various additives on enzymatic hydrolysis of castor oil. *Biochemical Engineering Journal*, 47(1-3), 93-99.

Rooney, D., & Weatherley, L. (2001). The effect of reaction conditions upon lipase catalysed hydrolysis of high oleate sunflower oil in a stirred liquid–liquid reactor. *Process Biochemistry*, *36*(10), 947-953.

S Thaiphanit, G. S., P Anprung. (2016). Effects of coconut (Cocos nucifera L.) protein hydrolysates obtained from enzymatic hydrolysis on the stability and rheological properties of oil-in-water emulsions. *Food Hydrocolloids*, 252-264.

Serri, N., Kamarudin, A., & Rahaman, A. (2008). Preliminary studies for production of fatty acids from hydrolysis of cooking palm oil using C. rugosa lipase. *Journal of physical science*, 19(1), 79-88.

Sharma, A., Chaurasia, S. P., & Dalai, A. K. (2013). Enzymatic hydrolysis of cod liver oil for the fatty acids production. *Catalysis today*, 207, 93-100.

Sri Handayani, A. T. T. P., Siswati Setiasih and Sumi Hudiyono. (2019). Enzymatic Synthesis of Glyserol-Coconut Oil Fatty Acid and Glycerol-Decanoic Acis Ester as Emulsifier and Antimicrobial Agents Using Candida rugosa Lipase EC.

Togayhan Kutluk, B. G. K. (2022). A commercial lipase Resinase® HT (Aspergillus oryzae) efficiency on triglycerides transesterification and process optimization. *Sustainable Chemistry and Pharmacy*.

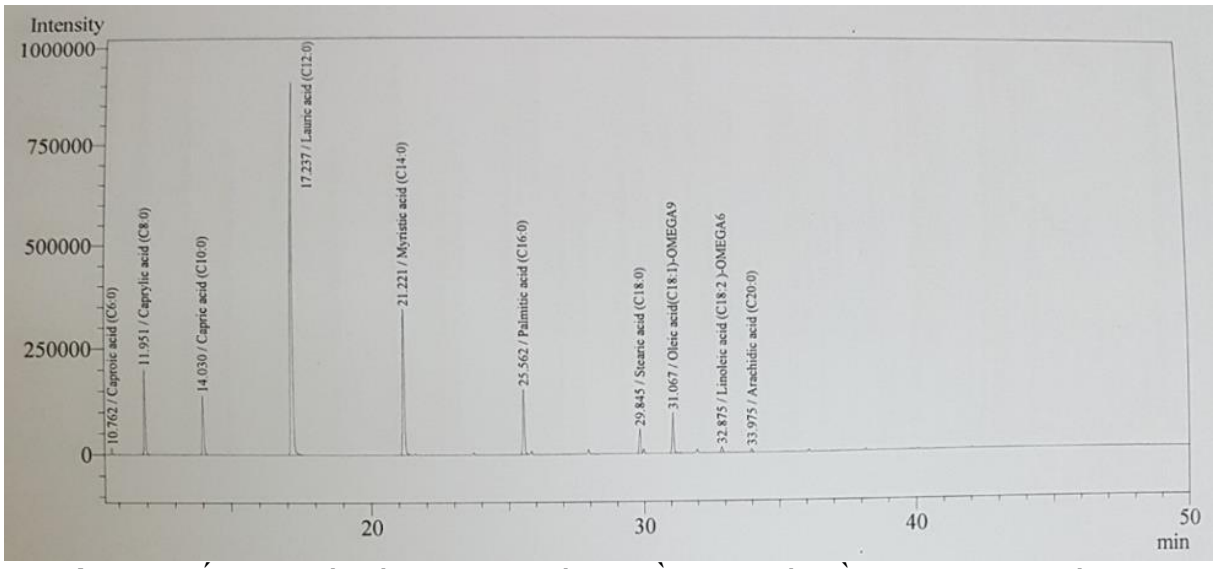
Van, N. T. A. (2020). NGHIÊN CỨU THỦY PHÂN TRIGLYCERIDE TRONG DẦU DỪA ĐỂ THU NHẬN CÁC PHÂN ĐOẠN ACID BÉO TỰ DO CÓ HOẠT TÍNH SINH HỌC.

VK Rathod, A. P. (2009). Effect of various additives on enzymatic hydrolysis of castor oil. *Biochemical Engineering Journal*.

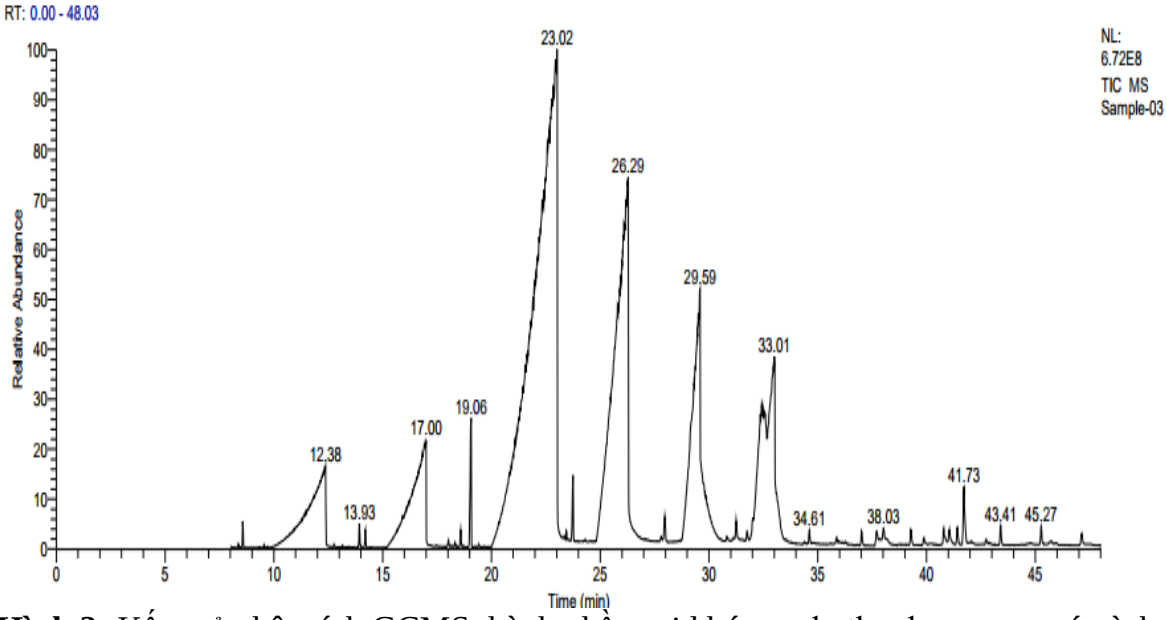
Yadav, G. D., & Devi, K. M. (2004). Kinetics of hydrolysis of tetrahydrofurfuryl butyrate in a three phase system containing immobilized lipase from Candida antarctica. *Biochemical Engineering Journal, 17*(1), 57-63.

Zenevicz, M. C. P., Jacques, A., Furigo Jr, A. F., Oliveira, J. V., & de Oliveira, D. (2016). Enzymatic hydrolysis of soybean and waste cooking oils under ultrasound system. *Industrial Crops and Products*, 80, 235-241.

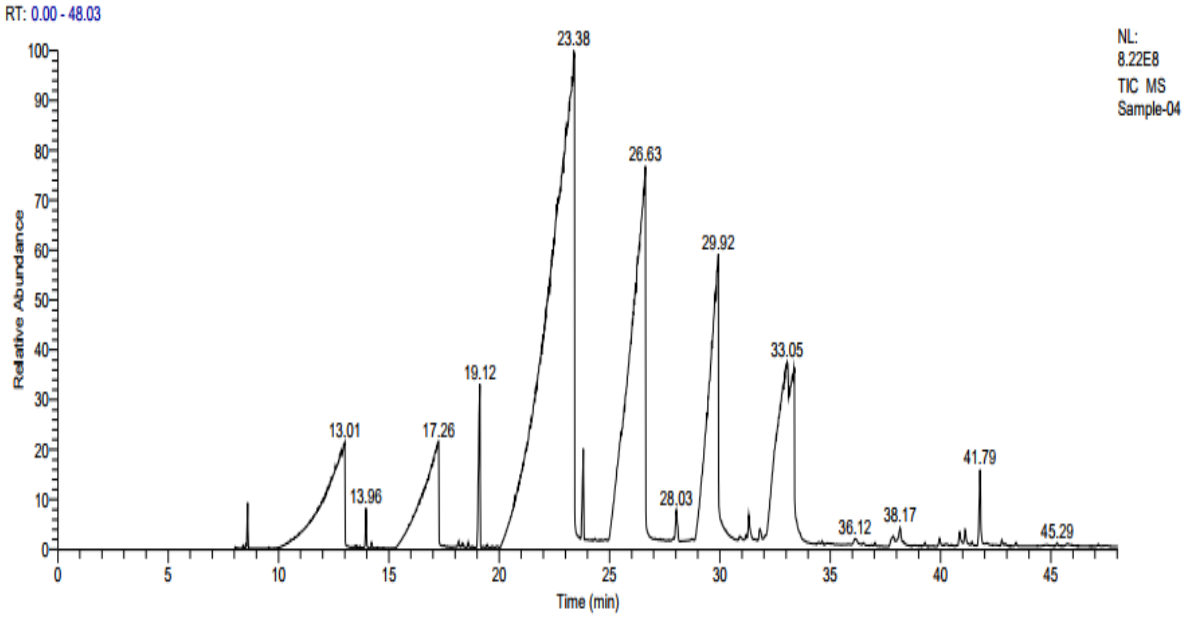
PHỤ LỤC A – KẾT QUẢ PHÂN TÍCH GC-MS



Hình 1: Kết quả phân tích GCMS thành phần acid béo dầu dừa tinh nguyên liệu



Hình 2: Kết quả phân tích GCMS thành phần acid béo tự do thu được sau quá trình thủy phân dầu dừa sử dụng xúc tác enzyme lipase từ *Candida rugosa*



Hình 3: Kết quả phân tích GCMS thành phần acid béo tự do thu được sau quá trình thủy phân dầu dừa sử dụng xúc tác enzyme lipase từ *Aspergillus oryzae*.

PHỤ LỤC B – KẾT QUẢ PHÂN TÍCH ANOVA

1. Ảnh hưởng của Hàm lượng enzyme lipase

a. Enzyme lipase từ *Candida rugose*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1133.950	5	226.790	650.749	<.001
Within Groups	4.182	12	.349		
Total	1138.132	17			

VAR00003

Tukey HSD[a]

NongDo	N	Subset for alpha = 0.05			
		1	2	3	4
0.5%	3	33.0843			
1%	3		44.4241		
1.5%	3			50.7370	
2.5%	3				54.2442
2%	3				54.9456
3%	3				55.1794
Sig.		1.000	1.000	1.000	.425

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Enzyme lipase từ *Aspergillus oryzae*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	902.918	5	180.584	600.600	<.001
Within Groups	3.608	12	.301		
Total	906.526	17			

VAR00003

Tukey HSD[a]

NongDo	N	Subset for alpha = 0.05				
		1	2	3	4	5
0.5%	3	15.6653				
1%	3		23.3811			
1.5%	3			28.5250		
2%	3				31.7983	
2.5%	3					35.3055
3%	3					35.7731
Sig.		1.000	1.000	1.000	1.000	.894

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

2. Ảnh hưởng của tỉ lệ dầu dừa/đệm

a. Enzyme lipase từ *Candida rugose*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1512.960	4	378.240	250.685	<.001
Within Groups	15.088	10	1.509		
Total	1528.048	14			

VAR00003

Tukey HSD[a]

TiLe	N	Subset for alpha = 0.05			
		1	2	3	4
1:1	3	29.6940			
1:2	3		45.3594		
1:5	3			52.8413	
1:3	3			54.9456	54.9456
1:4	3				57.5175
Sig.		1.000	1.000	.292	.151

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Enzyme lipase từ *Aspergillus oryzae*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	273.885	4	68.471	48.547	<.001
Within Groups	14.104	10	1.410		
Total	287.989	14			

VAR00003

Tukey HSD[a]

		Subset for alpha = 0.05		
TiLe	N	1	2	3
1:1	3	23.3811		
1:5	3		30.8631	
1:2	3		31.0969	
1:4	3			34.8379
1:3	3			35.3055
Sig.		1.000	.999	.987

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

3. Ảnh hưởng của pH

a. Enzyme lipase từ *Candida rugose*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	225.865	4	56.466	53.797	<.001
Within Groups	10.496	10	1.050		
Total	236.361	14			

VAR00003

Tukey HSD[a]

pH	N	Subset for alpha = 0.05		
		1	2	3
8	3	48.3989		
6	3	50.2694	50.2694	
6.5	3		52.8413	
7	3			57.5175
7.5	3			58.2190
Sig.		.242	.070	.912

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Enzyme lipase từ *Aspergillus oryzae*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	103.453	4	25.863	112.643	<.001
Within Groups	2.296	10	.230		
Total	105.749	14			

VAR00003

Tukey HSD[a]

pH	N	Subset for alpha = 0.05			
		1	2	3	4
8	3	27.8235			
6	3		29.9278		
7.5	3			32.2659	
6.5	3			33.4350	
7	3				35.3055
Sig.		1.000	1.000	.080	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

4. Ảnh hưởng của Nhiệt độ

a. Enzyme lipase từ *Candida rugose*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1122.108	5	224.422	132.426	<.001
Within Groups	20.336	12	1.695		
Total	1142.444	17			

VAR00003

Tukey HSD[a]

		Subset for alpha = 0.05			
NhietDo	N	1	2	3	4
55	3	35.7731			
50	3		40.6831		
30	3		43.9565		
45	3			52.6075	
35	3			53.5427	
40	3				58.2190
Sig.		1.000	.079	.944	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Enzyme lipase từ *Aspergillus oryzae*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	323.878	5	64.776	45.573	<.001
Within Groups	17.056	12	1.421		
Total	340.935	17			

VAR00003

Tukey HSD[a]

NhietDo	N	Subset for alpha = 0.05			
		1	2	3	4
55	3	22.2121			
30	3		25.7192		
50	3		27.3559		
35	3			30.8631	
45	3			31.3307	
40	3				35.3055
Sig.		1.000	.567	.996	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

5. Ảnh hưởng của tỉ lệ iso octan/ dầu dừa

a. Enzyme lipase từ *Candida rugose*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	323.878	5	64.776	45.573	<.001
Within Groups	17.056	12	1.421		
Total	340.935	17			

VAR00003

Tukey HSD[a]

NhietDo	N	Subset for alpha = 0.05			
		1	2	3	4
55	3	22.2121			
30	3		25.7192		
50	3		27.3559		
35	3			30.8631	
45	3			31.3307	
40	3				35.3055
Sig.		1.000	.567	.996	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Enzyme lipase từ *Aspergillus oryzae*

ANOVA

VAR00003

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	156.000	4	39.000	54.045	<.001
Within Groups	7.216	10	.722		
Total	163.216	14			

VAR00003

Tukey HSD[a]

		Subset for alpha = 0.05			
TLDungMoi	N	1	2	3	4
2:1	3	26.8883			
1.5:1	3		29.6940		
1:1	3			32.4997	
0.5:1	3				35.0717
0	3				35.3055
Sig.		1.000	1.000	1.000	.997

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.