

Supplement

Petrodiesel Blend Study for Biodiesel Production from *Bauhinia variegata* Seed Oil

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Table S1 Face-Centered Central Composite Design (F-CCD) design level for microwave-assisted transesterification (MAT)

Independent variables	Unit	Levels		
		–1	0	+1
Oil to methanol ratio	v/v	1:4	1:7	1:10
Catalyst concentration	wt%	0.5	1	1.5
Power	W	300	450	600
Time	min	5	10	15

Table S2 Experimental values of F-CCD design

Run	Space type	A: Oil to methanol ratio	B: Catalyst concentration	C: Power	D: Time	Biodiesel yield (%)	
		v/v	wt%	W	min	X_{Exp}^*	X_{Pre}^{**}
1	Factorial	10 (+1)	0.5(–1)	300(–1)	15(+1)	64.86 ± 0.12	65.09
2	Axial	7(0)	1(0)	600(+1)	10(0)	85.93 ± 0.06	86.93
3	Factorial	4(–1)	1.5(+1)	300(–1)	15(+1)	74.72 ± 0.11	74.86
4	Center	7(0)	1(0)	450(0)	10(0)	97.02 ± 0.14	96.48
5	Factorial	10(+1)	0.5(–1)	300(–1)	5(–1)	69.90 ± 0.09	69.76
6	Center	7(0)	1(0)	450(0)	10(0)	96.98 ± 0.08	96.48
7	Factorial	4(–1)	0.5(–1)	600(+1)	5(–1)	58.01 ± 0.17	58.24
8	Factorial	10(+1)	1.5(+1)	300(–1)	5(–1)	67.35 ± 0.22	67.43
9	Axial	7(0)	1(0)	450(0)	5(–1)	91.07 ± 0.09	91.79
10	Factorial	4(–1)	0.5(–1)	600(+1)	15(+1)	57.99 ± 0.02	57.83
11	Axial	7(0)	0.5(–1)	450(0)	10(0)	85.01 ± 0.31	85.99
12	Factorial	4(–1)	1.5(+1)	300(–1)	5(–1)	64.72 ± 0.24	64.66
13	Axial	7(0)	1.5(+1)	450(0)	10(0)	88.46 ± 0.16	89.43
14	Factorial	10(+1)	1.5(+1)	300(–1)	15(+1)	67.89 ± 0.11	67.26
15	Factorial	4(–1)	0.5(–1)	300(–1)	5(–1)	58.33 ± 0.26	58.10
16	Factorial	4(–1)	1.5(+1)	600(+1)	15(+1)	67.29 ± 0.14	67.03
17	Axial	4(–1)	1(0)	450(0)	10(0)	84.55 ± 0.08	85.53
18	Center	7(0)	1(0)	450(0)	10(0)	95.48 ± 0.12	96.48
19	Factorial	4(–1)	1.5(+1)	600(1)	5(–1)	63.27 ± 0.09	62.95
20	Factorial	4(–1)	0.5(–1)	300(–1)	15(+1)	64.14 ± 0.11	63.80
21	Factorial	10(+1)	1.5(+1)	600(+1)	5(–1)	69.13 ± 0.06	69.07
22	Factorial	10(+1)	1.5(+1)	600(+1)	15(+1)	62.64 ± 0.27	62.78
23	Center	7(0)	1(0)	450(0)	10(0)	96.92 ± 0.03	96.48

Table S2 Experimental values of F-CCD design (continued)

Run	Space type	A: Oil to methanol ratio	B: Catalyst concentration	C: Power	D: Time	Biodiesel yield (%)	
		v/v	wt%	W	min	X_{Exp}^*	X_{Pre}^{**}
24	Axial	7(0)	1(0)	300(−1)	10(0)	88.15 ± 0.33	89.10
25	Center	7(0)	1(0)	450(0)	10(0)	96.88 ± 0.09	96.48
26	Axial	10(+1)	1(0)	450(0)	10(0)	88.27 ± 0.12	89.23
27	Factorial	10(+1)	0.5(−1)	600(+1)	15(+1)	62.8 ± 0.24	62.46
28	Factorial	10(+1)	0.5(−1)	600(+1)	5(−1)	73.47 ± 0.18	73.24
29	Center	7(0)	1(0)	450(0)	10(0)	97.10 ± 0.12	96.48
30	Axial	7(0)	1(0)	450(0)	15(+1)	90.28 ± 0.09	91.50

* $X_{Exp} - X_{Experimental\ value}$

** $X_{Pre} - X_{Predicted\ value}$

Table S3 ANOVA results of MAT process

Source	Sum of squares	Coefficient	Mean square	F-value	p-value
Model	5967.26	96.48	426.23	392.31	<0.0001**
X_1 -Oil to methanol ratio	61.57	1.85	61.57	56.67	<0.0001**
X_2 -Catalyst concentration	53.25	1.72	53.25	49.01	<0.0001**
X_3 -Power	21.19	−1.09	21.19	19.50	0.0005*
X_4 -Time	0.3872	−0.146	0.3872	0.3564	0.5594ns
$X_1 X_2$	78.99	−2.22	78.99	72.70	<0.0001**
$X_1 X_3$	11.21	0.836	11.21	10.31	0.0058*
$X_1 X_4$	107.49	−2.59	107.49	98.93	<0.0001**
$X_2 X_3$	3.41	−0.461	3.41	3.14	0.0966ns
$X_2 X_4$	20.23	1.12	20.23	18.62	0.0006*
$X_3 X_4$	37.42	−1.53	37.42	34.45	<0.0001**
X_1^2	214.78	−9.10	214.78	197.69	<0.0001**
X_2^2	199.72	−8.78	199.72	183.82	<0.0001**
X_3^2	186.09	−8.47	186.09	171.27	<0.0001**
X_4^2	60.69	−4.84	60.69	55.86	<0.0001**
Residual	16.30		1.09		
Lack of fit	14.40		1.44	3.80	0.0767ns
Pure error	1.89		0.3789		
Cor total	5983.56				
Predicted residual error sum of squares	47.60	R^2		0.9973	
Standard deviation	1.04	Adjusted R^2	0.9947		
Mean	77.77	Predicted R^2	0.9920		
Coefficient of variation %	1.34	Adequate precision	52.45		

*Significant, **Highly significant, ns – nonsignificant

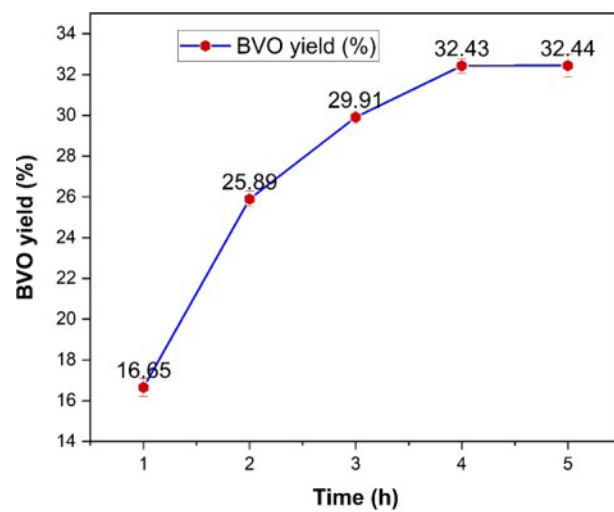


Fig. S1 Optimization of BVO yield over time