**Supplementary document**

**Heterogeneously catalyzed palm biodiesel production in intensified fruit blender**

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**ANOVA results**

Variables:

Methanol to oil molar ratio

6:1 = X1

9:1 = X2

12:1 = X3

15:1 = X4

Catalyst (wt.%)

1 = X5

5 = X6

10 = X7

Reaction temperature (oC)

50 = X8

55 = X9

60 = X10

Reaction volume (mL)

1,000 = X11

1,500 = X12

2,000 = X13

**Table S1** Analysis of variance on FAME yield.

|  |  |
| --- | --- |
| Factor | P-value |
| Reaction time (min) |
| 30 | 60 | 90 | 120 |
| Methanol: Oil molar ratio | X1X2 | 0.810 | 0.985 | 0.072 | 0.143 |
| X1X3 | 0.440 | 0.079 | 0.032 | 0.109 |
| X1X4 | 0.163 | 0.001 | 0.001 | 0.013 |
| X2X3 | 0.861 | 0.107 | 0.741 | 0.989 |
| X2X4 | 0.383 | 0.001 | 0.003 | 0.102 |
| X3X4 | 0.739 | 0.003 | 0.005 | 0.134 |
| Catalyst (wt.%) | X5X6 | 0.001 | 0.003 | 0.003 | 0.003 |
| X5X7 | 0.085 | 0.172 | 0.428 | 0.005 |
| X6X7 | 0.001 | 0.002 | 0.004 | 0.428 |
| Reaction temperature (oC) | X8X9 | 0.362 | 0.233 | 0.625 | 0.997 |
| X8X10 | 0.543 | 0.708 | 0.942 | 0.965 |
| X9X10 | 0.895 | 0.494 | 0.795 | 0.981 |
| Reaction volume (mL) | X11X12 | 0.782 | 0.012 | 0.232 | 0.144 |
| X11X13 | 0.272 | 0.010 | 0.299 | 0.425 |
| X12X13 | 0.150 | 0.978 | 0.957 | 0.513 |

The analysis of variance (ANOVA) was used to determine the significant mean differences of FAME yield within each variable group through Tukey HSD's procedure with statistical significance at a 95% confidence level. The significance of each parameter was determined by P-values as shown in Table S1. It was noticed that at least one pair of methanol: oil molar ratios differed significantly at 60 and 90 min, and that the catalyst levels differed significantly at all reaction times, while neither the reaction temperature nor the reaction volume variables were significantly different at all levels over reaction time.