

1 **Supplementary Data**

2 Lipase-catalyzed ethanolysis for biodiesel production of untreated palm oil  
3 mill effluent in water-containing system

4

5 **Nova Rachmadona<sup>1</sup>, Jerome Amoah<sup>2</sup>, Emmanuel Quayson<sup>1</sup>, Shinji Hama<sup>3</sup>, Ayumi  
6 Yoshida<sup>3</sup>, Akihiko Kondo<sup>2</sup> and Chiaki Ogino<sup>1,\*</sup>**

7

8 <sup>1</sup>Department of Chemical Science and Engineering, Graduate School of Engineering,  
9 Kobe University, 1-1 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan

10 <sup>2</sup>Graduate School of Science, Technology and Innovation, Kobe University, 1-1  
11 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan

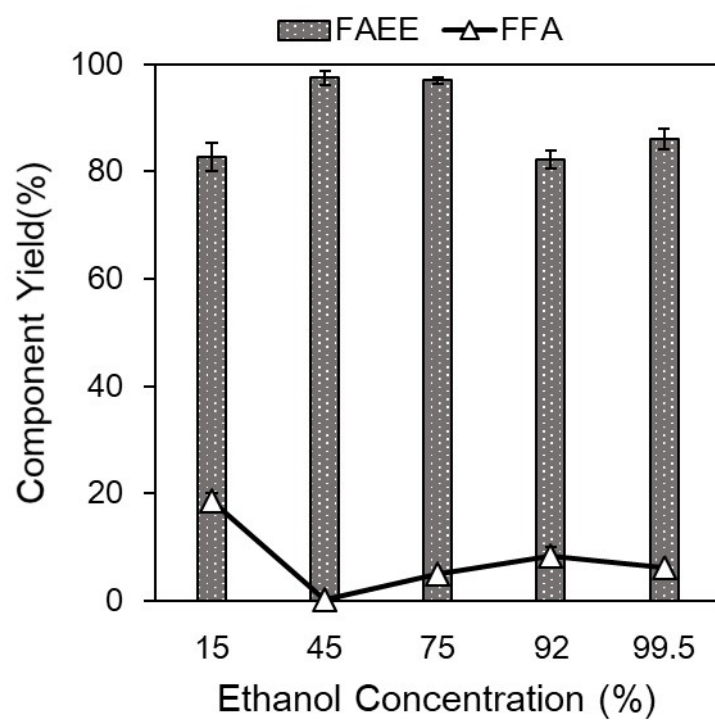
12 <sup>3</sup>Bio-energy Corporation, Research and Development Laboratory, 2-9-7  
13 Minaminanamatsu, Amagasaki 660-0053, Japan

14

15 \*Corresponding author: Department of Chemical Science and Engineering, Graduate  
16 School of Engineering, Kobe University, 1-1 Rokkodai-cho, Nada-ku, Kobe 657-8501,  
17 Japan

18 E-mail address: [ochiaki@port.kobe-u.ac.jp](mailto:ochiaki@port.kobe-u.ac.jp)

19

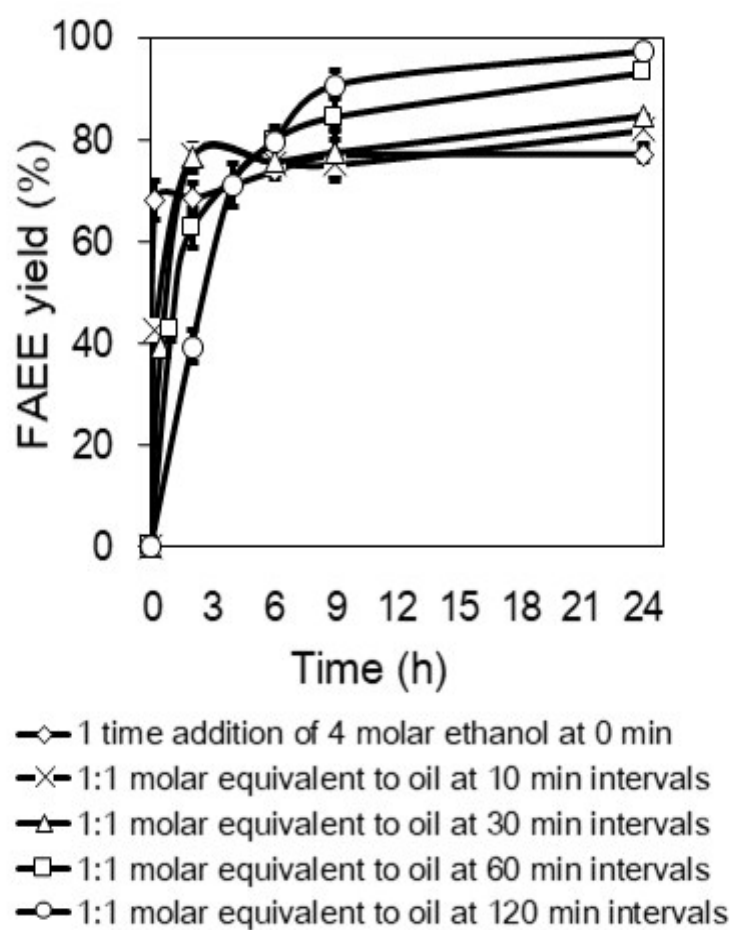


20

21 **Supplementary Fig. S1.** FFA residue at 24 h from variation of ethanol dilution.

22 Reaction conditions: POME to ethanol ratio (1:4), lipase loading (0.3 % v/w), water (5

23 % v/w), the total reaction time (24 h), temperature (40 °C) and stirring speed (500 rpm).



24

25 **Supplementary Fig. S2.** Effect of ethanol addition rate under process parameter:

26 ethanol concentration (45%), POME to ethanol molar ratio (1:4), lipase (0.3%), water

27 addition on lipase (4.7%), the total reaction time (24 h), temperature (40 °C) and stirring

28 speed (500 rpm).