Supplementary

Catalytic cracking of triglycerides with a base catalyst and modification of pyrolytic oils for production of aviation fuels

Fanglin Li [a], Jianchun Jiang [a, b], Peng Liu [a], Qiaolong Zhai [a], Fei Wang [a], Chung-yun Hse [c], Junming Xu [a, b *]

a. Institute of Chemical Industry of Forest Products, CAF, National Engineering Lab. for Biomass Chemical Utilization, Key Lab. of Biomass Energy and Materials of Jiangsu Province, Nanjing 210042, China.

b. Research Institute for Forestry New Technology, Chinese Academy of Forestry, Beijing 100091,China.

c. United States Department of Agriculture Forest Service, Southern Research Station, Pineville, LA 71360, USA

The triglycerides based on plant oils or waste oils were cracked with 5wt% Na_2CO_3 catalyst. The diesel fraction was distilled from the liquid fuel obtained by catalytic cracking, which was weighed and analyzed. The yield of this fraction is calculated based on the original feedstock, and the results were shown in Table S1. The components and carbon chain distribution in diesel fraction obtained from different feedstocks were summarized in Table S2 and Fig S1, respectively. In addition, the main components of the diesel fraction obtained from different feedstocks were detected and quantified with GC-MS and GC-FID, respectively (Table S2).

Table. S1. Catalytic cracking of different feedstocks over 5 wt% Na_2CO_3.

Feedstock	Diesel fraction		Residual oil	Liquid fuel	Water	Coke	Gas
	Yield /%	Acid value /mg KOH·g^{-1}	Yield /%	Yield /%	Yield /%	Yield /%	Yield /%
Soybean oil	25.6±2.0	8.9±1.6	2.7±0.3	69.6±0.5	4.4±0.4	12.4±1.4	13.6±0.8
Rubber seed oil	21.7±2.9	26.4±2.4	18.4±0.6	61±0.5	5.2±0.7	2.1±0.1	32±0.9
Waste cooking oil	41±1.3	16.6±1.2	4.3±0.4	76±1.0	4.6±0.1	9.8±0.5	9.6±1.6
Acidified oil	31.8±2.2	22.3±2	5±0.3	63.7±1.5	6.4±0.3	6.5±0.9	21.9±0.4

* Corresponding author. Tel: +86 2585482478
E-mail: lang811023@163.com

Table. S2. Distribution of the diesel fraction obtained from different feedstocks.

Feedstock	Alkanes	Alkenes	Aromatics	Carboxylic acids	Ketones	Others
Soybean oil	50.9	32.9	0	0	7.8	8.4
Rubber seed oil	42.2	43.2	0	1.8	6.7	6.1
Waste cooking oil	50.2	36.9	0	2.8	6.6	3.5
Acidified oil	33.4	25.4	2.3	13.1	19.8	6

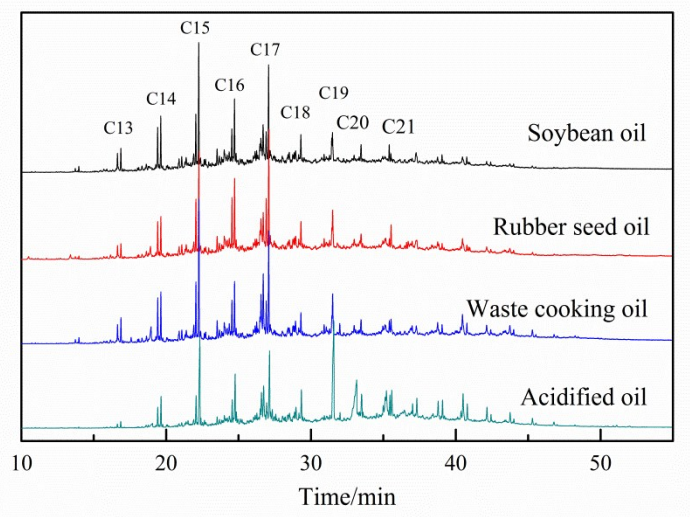

Fig. S1. GC-MS of the diesel fraction obtained from different feedstocks

As shown in Table S2, there are some alkenes ranging from 25% to 43% in the diesel fraction obtained from different feedstocks, which would reduce the performance of the fuel. Therefore, the hydrogenation of the diesel fraction were processed with the catalyst of Pd/AC (5 wt%) at 200 °C and 6 MPa (H_2) for 6 h. The result was presented in Table S3. As shown in Table S4, the basic properties of diesel fraction were compared with that of 0# diesel. The density and heat value of the diesel fraction can meet the requirements of 0# diesel according to the standard of GB/T 19147-2003 in China, while other properties need to be further improved.

Table. S3. Distribution of the diesel fraction obtained from soybean oil before and after hydrogenation.

Product	Alkanes	Alkenes	Aromatics	Carboxylic acids	Ketones	Others
#1	50.9	32.9	0	0	7.8	8.4
#2	76.9	4.1	0	0	7.4	11.6

#1: the pyrolytic diesel fraction; #2: the hydrogenated diesel fraction.

Table. S4. Basic properties of the diesel fraction obtained from soybean oil before and after hydrogenation.

Physical chemical properties	Pyrolytic diesel fraction	hydrogenated diesel fraction	0# diesel[b]
Density[a] ($kg \cdot m^{-3}$)	873	868	820-860
Heat value ($MJ \cdot kg^{-1}$)	43.7	44.2	≈43
Viscosity[a] ($mm^2 \cdot s^{-1}$)	9.71	10.26	3.0-8.0
Acid value (mg $KOH \cdot g^{-1}$)	8.9	8.8	-
Condensation point (°C)	7	6	0

a Measured at 20 °C. b Refers to GB/T 19147-2003 in China.

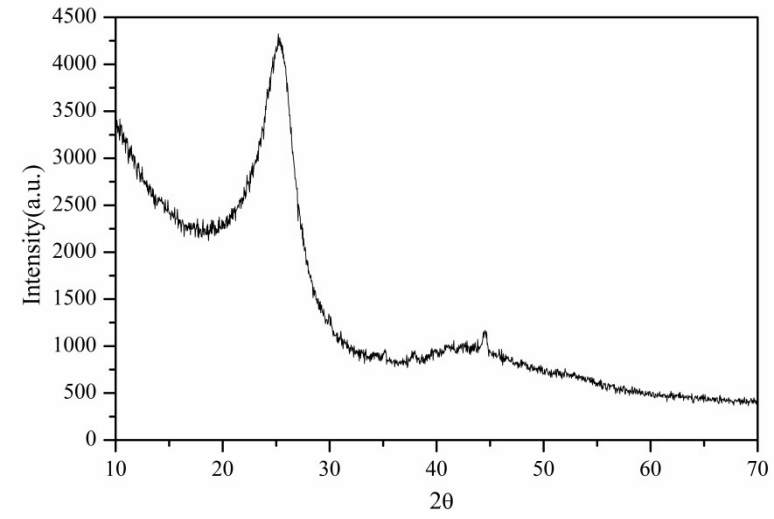

Fig. S2. XRD of the coke formed in the process of catalytic cracking of soybean oil.