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Determination of Some Properties of Used Cooking Oil using AAS, Bomb Calorimeter and GC-MS Techniques

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ABSTRACT

Most of the used cooking oil from households and catering premises in Malaysia will eventually ends up in wastewaters. It will be discharged to the surface of waters because no alternative steps were taken to overcome the waste from used cooking oil. As a component of wastewater, oil is classified together with fats and waxes as grease. This trend results in the generation of a vast waste stream that needs to be properly managed to avoid environmental damage. Thus, the information regarding on the waste cooking oil properties is needed to contribute knowledge for future research where the waste may reformed to value added product. Preliminary analysis of used cooking oil properties via GCMS using capillary column shows n-Hexadecanoic acid and Oleic acid as the major compounds present in the used frying oil. The analysis for determination of volatile and moisture content with 3 replicates show an average of 0.02% moisture and volatile content, which the experimental procedure was based on MPOB Test Methods.

Key words: Environmental damage, Fats, GC-MS, Used cooking oil.

INTRODUCTION

Initially, most private households used to dispose of their used cooking oil by flushing it down the sink while used cooking oil in industry was transported to the manufacturer as raw material to produce feed to be used in farming or soap[1]. All too often used cooking oil is improperly disposed of by washing these messy, greasy residues down the kitchen plumbing system or by dumping it down the storm drain system[2]. Improperly disposing of leftover used cooking oil may cause property damage, health hazards and environmental problems[3]. Pipes may be blocked by oils poured directly into the sink, even if diluted with hot water. Polluted storm water runoff can lead to excessive and costly maintenance and cleanup and could result in severe fines from State and Federal regulatory agencies[4]. Stringent Malaysian legislation promotes the application of novel recycling technologies capable of absorbing large amounts of waste inclusive waste cooking oil.

The aim was to determine the properties of used cooking oil using some selected techniques for consideration of future potential as raw material for biofuel production.

EXPERIMENTAL

Raw Material

Used cooking oil (palm oil) was obtained from Faculty of Hotel and Catering, Universiti Teknologi MARA. The sample was first heated in the oven at 100-110 °C for 10 minutes to remove the moisture. Meanwhile, other sample was heated in the furnace at temperature 550 °C for 4 hours to determine the ash content.

Analysis of Heavy Metal

The sample was analyzed using Atomic Absorption Spectrometer (Perkin Elmer) to determine the heavy metal content using Cadmium, Chromium, Nickel and Plumbum lamp. The level of detection is ppm range. The standard were prepared at 1ppm, 2ppm, 3ppm, 4ppm and 5ppm. The samples were prepared according to MPOB Test Method[5].

Calorific Value

The samples was placed in the autosampler and analyzed by Bomb Calorimeter (IKA_Werke; Adibatic Mode for 25 minutes).

Analytical Method

The Gas Chromatography-Mass Spectroscopy (Agilent) was used to determine the compounds in a sample. Qualitative results of used cooking oil were obtained from the GC-MS library. GC-MS serves to separate mixtures into specific components using Agilent HP5MS column (30.0m×250µm×0.25µm)/

RESULTS AND DISCUSSION

Proximate Analysis

´ Fixed carbon= 100-(%ash + %moisture + %volatile matter)
´ volatile matter and moisture= 0.078
´ ash content= 0.003
´ fixed carbon= 99.919

Low moisture and volatile content indicates the used cooking oil doesn't need pretreatment to remove the moisture prior processing and high fixed carbon indicates it rich with carbon content.

Calorific value

Calorific value (CV) for used cooking oil= 38.314MJ/kg

CV of used cooking oil higher than municipal solid waste (~ 14 MJ/kg), biomass (~17MJ/kg), empty fruit bunch/ free fruit bunch (~23MJ/kg)[1)]

AAS Analysis

Standard concentration: 1-5 ppm
´ Cr: absence
´ Ni: absence
´ Pb: absence
´ Cd: present at 0.041ppm (Fig. 1)

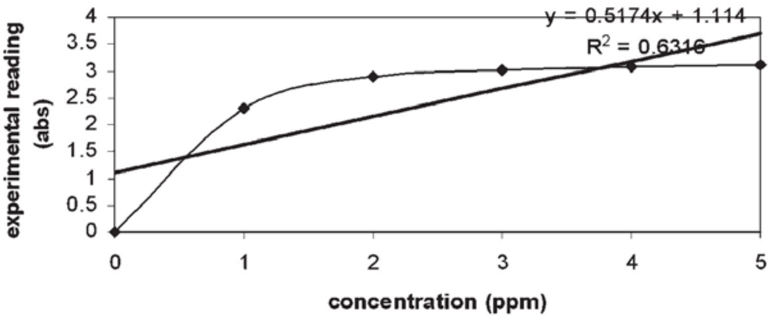

Fig. 1: Concentration of Cd in the used cooking oil

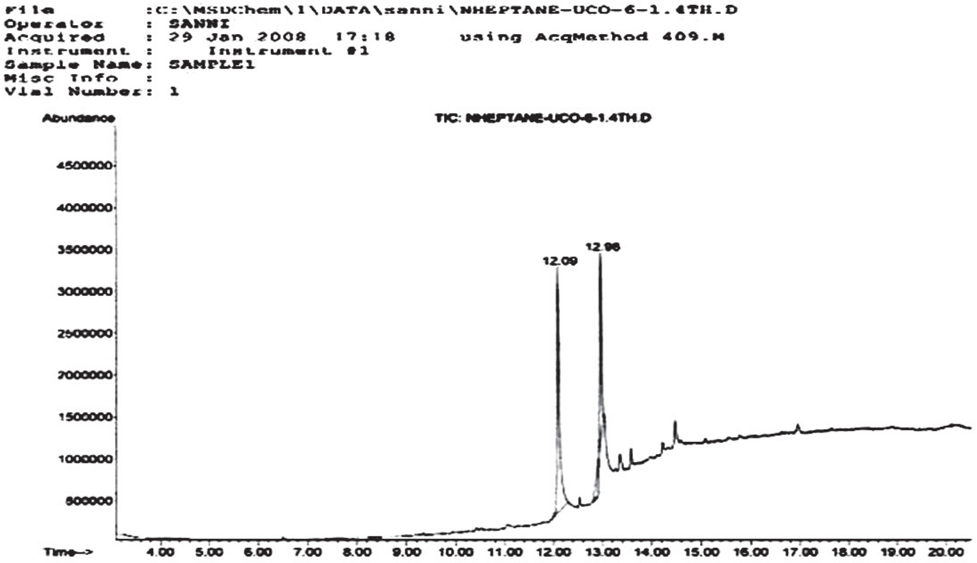

Fig. 2: GCMS Analysis of used cooking oil

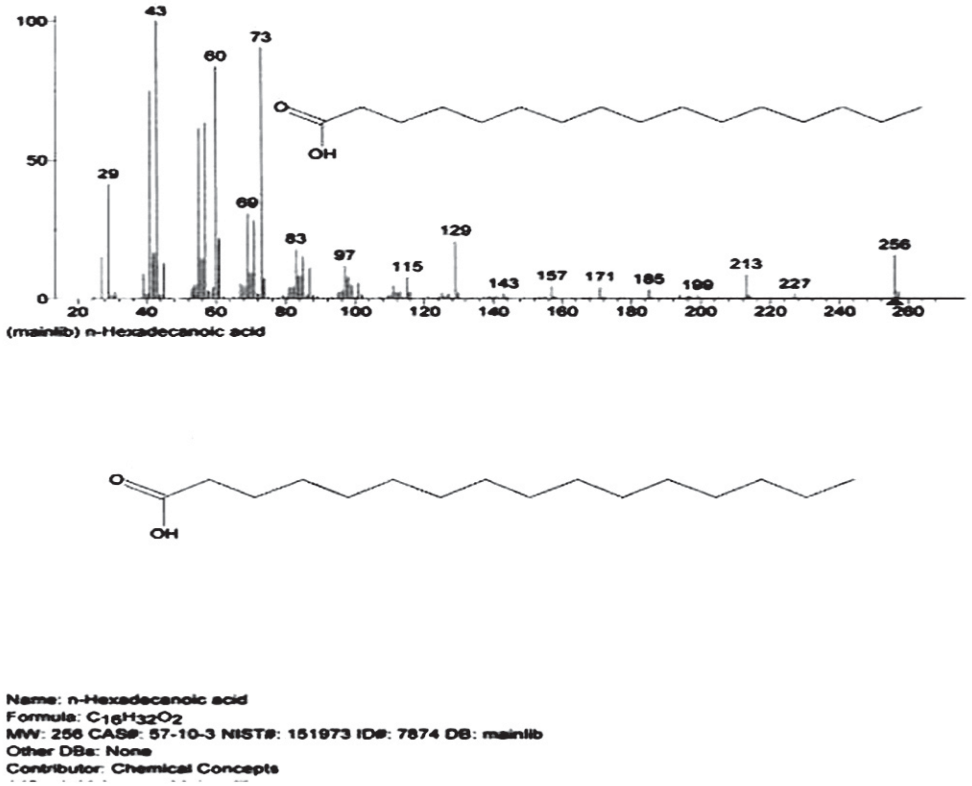

Fig. 3: n-Hexadecanoic acid properties obtained from GCMS library

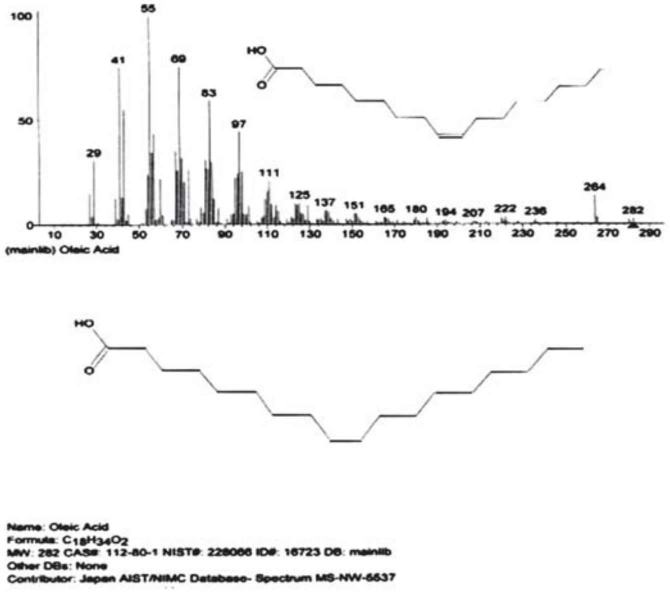

Fig. 4: Oleic acid properties obtained from GCMS library

Further analysis need to be done to detect Cu, Ca, Hg, As and trace metals at ppb level using ICP.

From the Least-square fit procedure, the calibration graph was plotted. It was found that R^2 is somewhat close to 1, indicating relative correlation coefficient between the data point[5].

The used cooking oil was rich with n-Hexadecanoic acid and Oleic acid. This suggested that the cooking oil is subjected as potential raw material for producing biofuel via catalytic cracking. The idea of '*cutting*' the long hydrocarbon to the short chain chain using chemical process is however still under way.

CONCLUSION

Besides biomass, used cooking oil is a very potential feedstock for production of bio-oil via pyrolysis regardless on cost perspective. It has high calorific value, low heavy metal content and low moisture. With long chain of n-hexadecanoic (palmitic) acid and oleic acid, it has the potential to be cracked to form shorter chain of hydrocarbon.

REFERENCES

1. Mangesh, G. K.; Ajay, K. D. Waste cooking oil an economical source for biodiesel: A Review. *Ind. Eng. Chem. Res.* **45**: 2901-2913 (2006).
2. Yu, C. W.; Bari, S.; Ameen, A. A comparison of combustion characteristics of waste cooking oil with diesel as fuel in a direct injection diesel engine. *Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering* **216**: 237-243 (2002).
3. Xiangmei, M.; Guanyi, C.; Yonghong, W. Biodiesel production from waste cooking oil via alkali catalyst and its engine test *Fuel Processing Technology* **89**: 851-857 (2008).
4. Cole Hills Associates. *New Hampshire Bio-Oil Assessment Analysis*, 11-12 (2005).
5. Malaysian Palm Oil Board (MPOB), *MPOB Test Method*, 445-660 (2005).