

Research on the entity of waste cooking oil: based on the comparison of the outcomes from peanut oil, soybean oil and corn oil

Wenjing Li, Guangming Li*, He Wenzhi, Zhu Haochen, Huang Juwen

College of Environmental Science and Engineering, Tongji University, No. 1239 Siping Road, Shanghai, 200092, China

Abstract

Waste cooking oil may cause environmental problems and threaten human's health if it cannot be treated properly. With the aim of dealing waste cooking oil properly, it is important to find out the entity of waste cooking oil. Waste cooking oil was edible oils, the imparity between them makes waste cooking oil 'waste'. In this paper, the outcome of cooked peanut oil, soybean oil and corn oil, cooking time and temperature have been measured and recorded.

The existence of the common ground of waste cooking oil made from different raw material makes it possible to do the research of treatment with model compound and avoid the trouble made by diversity of waste cooking oil. The components of them have been determined with GC-MS analysis and compared with each other to find the common ground of waste cooking oil. The results showed that all these outcomes have similar components and entity, and contain around 35% triglyceride, which can be a model compound in further research.

Keywords: Waste cooking oil, Quality and component, Common ground

1. Introduction

Waste cooking oil is non-edible oil generated in food production from vegetable and animal oil by the food industry, restaurants and homes [1]. It is accumulated in very large quantities each year in all countries [2], and because of the unique cooking methods, the amount of waste cooking oil in China is higher than other countries, can be no less than 1,000,000t/year[3]. And the amount is increasing these years, according to The Government Gazette in Shanghai as example.

Since waste cooking oil contains these a lot of organics, in volatile and non-volatile, releasing it into the environment can cause air pollution and eutrophication. During the cooking process and long storage, vitamin A, vitamin E, carotene and other nutrients in edible oil were destroyed, while three triacylglycerol was changed by hydrolysis reaction, auto oxidation and pyrolysis reactions, formation of free fatty acids, phenols, ketones, aldehydes and other small molecules and fatty acid polymer, which will do harm to health [4-6] if taken back to meals or fed to animals. This makes it necessary to deal with waste cooking oils properly, and to find out the entity of waste cooking oil.

Yin et al. analysed the components and the change of nutrient and harmful matter in edible oil after heating by gas chromatogram and mass spectra (GC/MS). The results showed that cooking oil contains hydrocarbons, alcohols and phenols, aldehydes and ketones, hydroxylic acids and derivatives, aromatic and heterocyclic compounds, and steroids, etc. [7].

Kang Li et al. collected 22mixtures of edible vegetable and bio-waste oils, 20 fried waste oils, 7 refined bio-waste oils, 9 original edible vegetable oil, 48 refined edible vegetable oil, 6 palm oils and 5 edible oils with flavor, oil samples were analyzed by gas phase chromatography tandem-mass spectrometry for the detection of undecanoic acid methyl ester and 13methyl tetradecanoic acid methyl ester. Results showed that dodecanoic acid and undecanoic acid can be characteristics for oils derived from animals and fried oil[8].

[*] Corresponding author: Professor in Environmental Science and Engineering, ligm@tongji.edu.cn

Studies were also made where the composition of edible oils changed into after cooking and the path of these reactions of some fatty acid, while this study focuses on the possible common composition of waste cooking oil.

2. Materials and method

2.1 Materials

Peanut, soybean and corn oils used in this study were obtained from a local Carrefour supermarket in Shanghai, China, while the Chinese cabbage was bought in another market. The fatty acid of the oils was determined by GC and given in Table 1.

Table 1. The fatty acid of the peanut, soybean and corn oil

Fatty acid	Peanut oil	Soybean oil	Corn oil
C14:0	-	0.07	-
C15:0	18.06	23.59	50.67
C15:1	-	0.03	0.11
C18:0	5.92	9.55	4.92
C18:1	52.4	23.68	29.53
C18:2	22.33	43.46	12.57
C18:3	-	0.53	-
C20:0	1.27	0.54	0.93
C20:1	-	0.07	0.17

The methanol and potassium hydroxide catalyst used for pre column derivatization had 99.9% purity, provided from Ourchem and Merck, respectively. The Potassium hydroxide and Sodium bisulfate monohydrate used in experiments were purchased from Sinopharm Chemical Reagent Co., Ltd.

2.2 Method

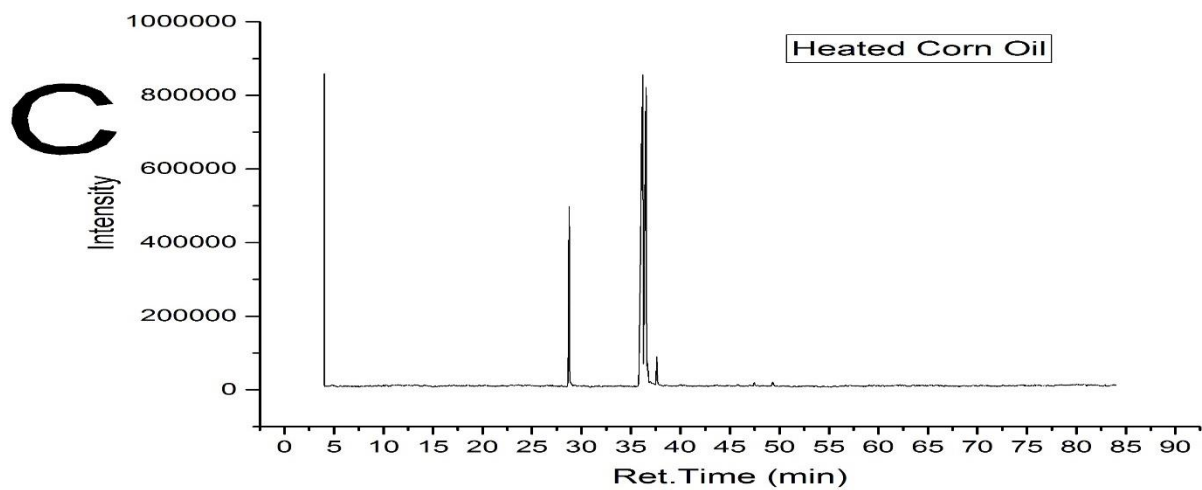
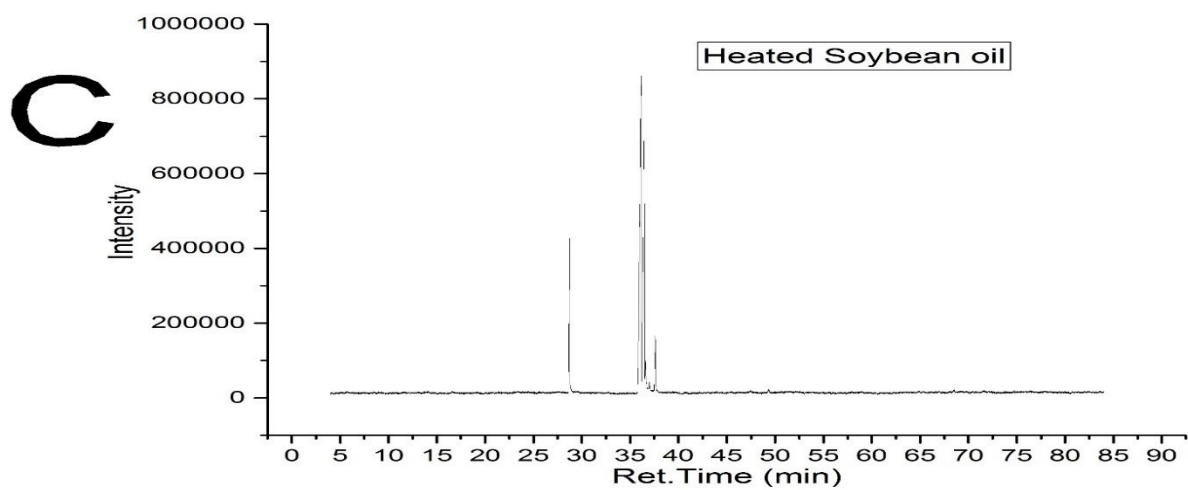
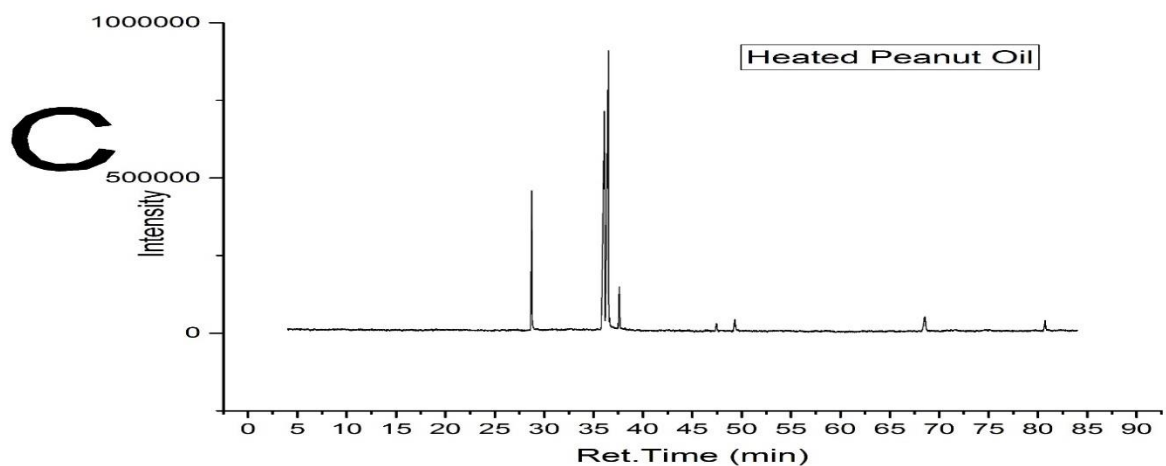
The experimental process was conducted on an electric stove with a power of 600W. 15ml of the oils were added in 100ml beakers. Then the electric stove was turned on and heated to a selected temperature. The selected temperature was 80% the smoke points of oils, for it is the best temperature of cooking cabbage in China. 30g of the Chinese cabbage were put into the beakers and started timing when the temperature reached the selected value. After the reaction, the samples were natural cooled. Other samples will be heated into the same temperature and kept being heated the same long.

After the reaction, the samples of cooking and heating were collected and prepared for GC-MS in the following way because the free fatty acid won't be changed in this method: Add 4mL isooctane to dissolve the sample. Add 200 L of potassium hydroxide and methanol solution. Cover with a glass stopper and shake vigorously. Let the 30s stand and settle until it is clear. Add about 1g sodium bisulfate, shake vigorously, and neutralize potassium hydroxide. After the salt is precipitated, the upper solution is moved to the machine bottle to be measured ^[9].

3. Results and discussion

3.1 The comparison of heated oil

In accordance with the same condition of chromatography and mass spectrometry, the instrument is adjusted and the oil samples are detected after processing. The TIC of heated samples is shown in Figure 1. The components are shown in Table2.



.Fig. 1. The TIC of heated samples

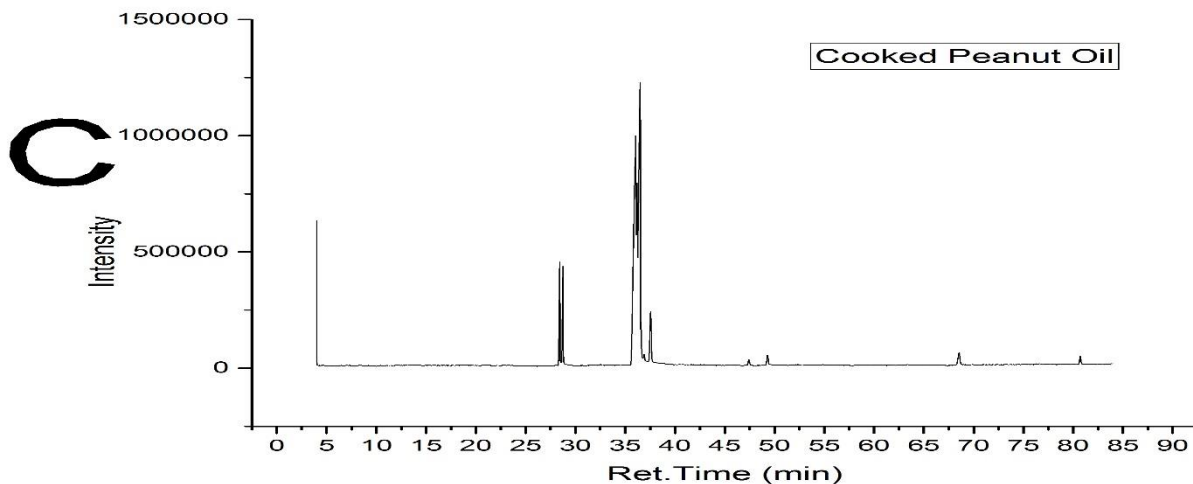
.Table2. The components of heated samples

Fatty acid	Peanut oil	Soybean oil	Corn oil
C15:0	24.79	22.24	45.05
C18:0	8.17	9.68	7.6
C18:1	36.36	22.88	19.01
C18:2	30.67	45.2	26.83

According to table 1, the oils and fats of five different raw materials have great differences. After heating, the content of oleic triglyceride and trilinolein in first two kinds of oil is close and over 60%, while in heated corn oil reached 45%, which is representative in all heated samples.

3.2 The comparison of cooked oil

In accordance with the same condition of chromatography and mass spectrometry, the instrument is adjusted and the oil samples are detected after processing. The TIC of cooked samples is shown in Figure 2. The components are shown in Table3.



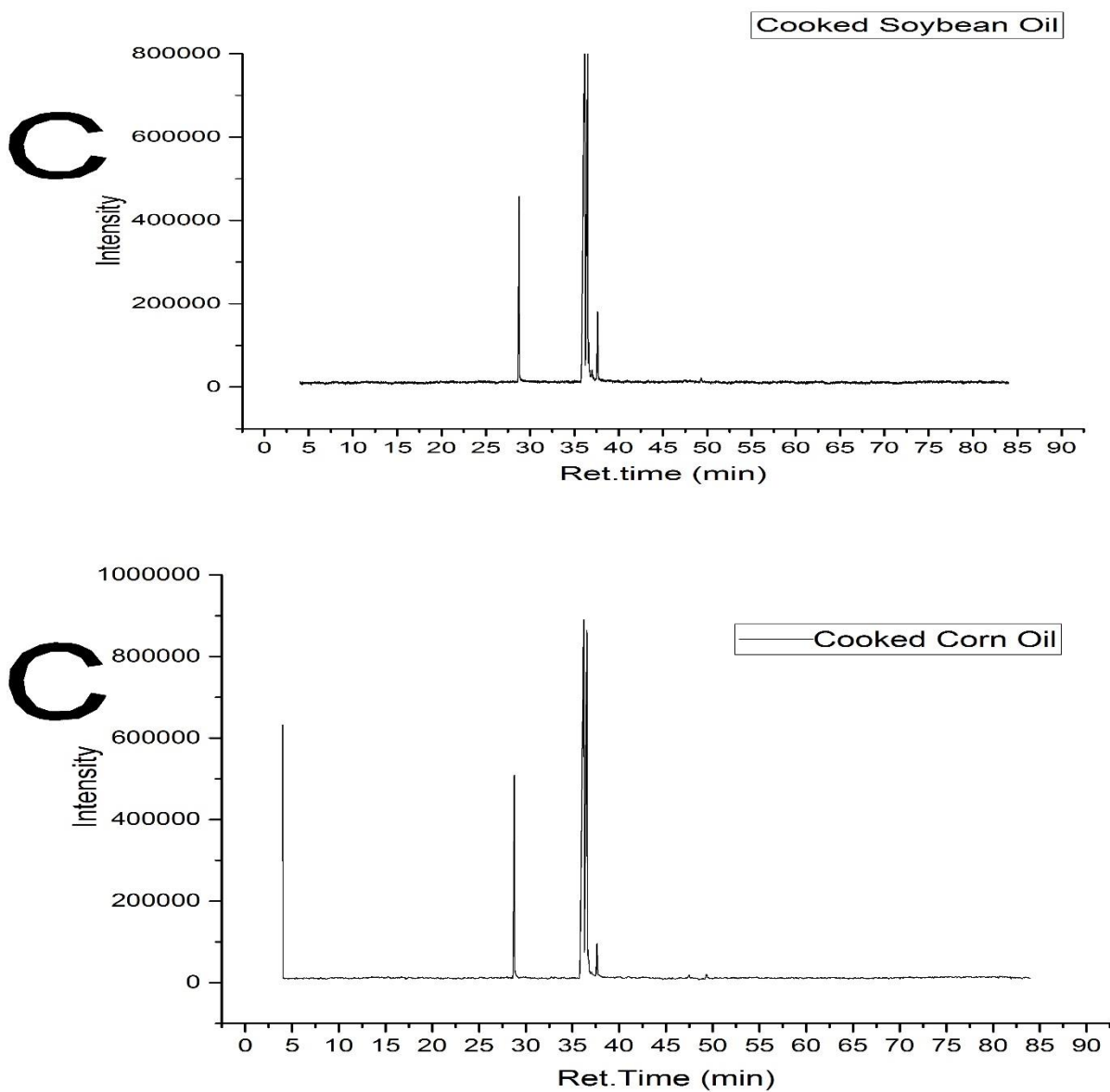


Fig. 2. The TIC of cooked samples

.Table3. The components of cooked samples

Fatty acid	Peanut oil	Soybean oil	Corn oil
C14:0	-	-	-
C15:0	16.38	22.53	39.93
C15:1	-	-	0.1
C18:0	13.48	9.64	6.8
C18:1	23.97	22.47	42.55
C18:2	44.64	45.35	8.32
C18:3	-	-	0.11

C20:0	1.53	-	1.29
C20:1	-	-	0.21

After cooking, the content of oleic triglyceride and trilinolein in first two kinds of oil is close and over 65%, while in heated corn oil reached 50%, which is representative in all cooked samples.

3.3 The compare of the changes after heating and cooking

In the heating process, changes of triglyceride content of linoleic acid oleic acid triglyceride, large and small changes in its content; in the process of cooking, there is a big decline in fifteen alkyl triglyceride content of oleic acid and linoleic acid triglyceride triglyceride content and is still relatively stable, further illustrate the mixture of triglycerides and oleic acid linoleic acid triglyceride is a model compound right.

The esterification of free fatty acids on not derivatization method selected, the fatty acid triglyceride in most of the existence of Yu San, the follow-up should replace the derivatization method, to determine the hydrolysis reaction and auto oxidation during cooking function.

4. Conclusion

The content of oleic triglyceride and trilinolein in first two kinds of oil is close and over 65%, while in heated corn oil over 45% and can stayed stable in heating and cooking, which make it feasible model compounds in further study.

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