ORIGINAL ARTICLE

Repeatedly Heating Cooking Oil among Food Premise Operators in Bukit Mertajam, Pulau Pinang and Determination of Peroxide in Cooking Oil

Adriana Abdul Aziz[1], Saliza Mohd Elias[1], Mohd Redzwan Sabran[2]

[1] Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor
[2] Department of Nurition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor

ABSTRACT

Introduction: The repeatedly heating cooking oil in preparation of fried food has become a main dietary habit among Malaysian which can cause health impacts on humans. The peroxide value (PV) can be applied to identify cooking oil's quality through the oxidative change that takes place in fats or oils. High peroxide value indicates bad quality of cooking oil. This research was conducted to identify the awareness and practice of repeatedly heating cooking oil among food premise operators and to determine the peroxide value in repeatedly heating cooking oil samples. **Methods:** A total of 124 food premise operators in Bukit Mertajam, Penang, participated in this research. A face-to-face interview was carried out by using the structured questionnaire for data collection to obtain socio-demographics information as well as awareness and practice of repeatedly heating cooking oil among respondents. The peroxide values analysis was performed on five samples of respondent's most favourable brands of cooking oil by using iodometric titration method. **Results:** Majority of respondents had moderate awareness (53.2%) and practice (50.0%) level regarding repeatedly heating cooking oil. The PV analysis showed that the peroxide value begin to exceed the AOCS standard limit of 10 meqO_2/kg following the 5th cycles of frying. **Conclusion:** Relevant actions need to be taken by the governmental food authorities to address this issue and ensure safe consumption of fried foods by consumers.

Keywords: Repeatedly heating cooking oil, Peroxide, Food premise operators, Malaysia

Corresponding Author:
Saliza Mohd Elias, PhD
E-mail: saliza_me@upm.edu.my
Tel: +603-89472402

INTRODUCTION

Nowadays, people's eating habits is shifted into eating outside, particularly for deep-frying food rather than cooking foods at home since we are living in a fast-paced society (1). The utilization of instant pan fried nourishment is high particularly in creating nations (2) as well as in Malaysia. Deep fried food is widely sold and available throughout the country due to its good taste, high demand and cheap price. This type of food is highly popular among consumers due to its availability (3). However, the consumption of deep-fried food has health implication if the food is cooked in repeatedly heated cooking oil. In fact, repeatedly heating cooking oil may result in unwanted hazardous substances which can pose harmful effects to the health.

A few reactions would take place during deep frying process, for instance, thermal polymeration, hydrolysis and rapid oxidation. As the length of frying is increased, the formation of oxidised and polymerised lipid species is accelerated, and hence deteriorates the quality of oil (4). Furthermore, when cooking oil is presented to high temperatures for drawn out stretches of time, it will causes the fatty acid peroxidation process and subsequently pose harmful effect for human health (5). Importantly, exceedingly oxidized unsaturated fats are devoured through the utilization of these seared nourishments. Eating rancid fat exposed consumers to deleterious health problems such as quickened maturing, elevated steroid alcohol levels, stoutness and increased weight (5). Many consumers and food handlers are not well knowledgeable regarding the damaging effects of overwhelming deep-fried food in repeatedly heated vegetable oil. For example, a previous study revealed that mainstream of food outlet operators had solely moderate or low level of information relating to the usage of repeatedly heated oil, and they had acknowledged of using the same cooking oil for several times before discarded it. (6).

Vegetable oil is a widely used lipid source for the daily life in terms of dietary intake. The premier oil used in Malaysia for cooking or frying purposes is palm oil which has 50% saturated and 50% unsaturated fatty acid which make them more stable than other vegetable oil. Oxidised oil produces a series of breakdown products in stages such as free fatty acids, peroxides aldehydes, carbonyls and trienes (7). Therefore, the assurance in oil quality is vital for the consumer's desirable consumption as oil is basically part of cooking ingredient especially in deep-frying food (4).

The oil's quality cannot be decided solely by view of naked eye through the observation of colour changes. Several tests such as determination of peroxide, free fatty acid, viscosities and anisidine have been used to assess the extent of oil's rancidity. Of these, the parameter to identify the oil degradation level by using peroxide numbers evaluation is the most widely used method as it demonstrates the level of oxidation within the substance and measures the total number of aggregate peroxides as a result of essential oil oxidation (7). The lower the PV indicates the fresher the oil. Crude pressed oil usually has PV of 5 to 20 meqO_2/kg while refine oil has PV between 0 to 1 meqO_2/kg.

To our best knowledge, there is limited literature and study conducted locally in Malaysia on the awareness and practice of repetitively heating cooking oil. Along these lines, this research's objective is to identify the awareness and practice of repeatedly heating cooking oil among food handlers as well as to determine the peroxide value in repeatedly heated cooking oil samples.

MATERIALS AND METHODS

Study background

A cross-sectional study was carried out on the food premise handlers in Bukit Mertajam, Penang from January to April 2017 (Figure 1). There were 213 food premises registered under Seberang Perai Municipal Council in Bukit Mertajam with an estimated population of 212,329 people (8). A total of 124 from 213 of food premise handlers were recruited by simple random sampling based on sample size calculation formula for one group of population by Lemeshow, Kar and Lwanga (9). The inclusion criteria for the selection of respondents for this research were citizens of Malaysia residing in Bukit Mertajam, aged at least 18 years old and use only vegetable-based oil in their food selling business.

Data Collection and Instrumentation

A modified questionnaire from Abdullah et al. was used to collect data from the respondents (6). A set of pre-tested bilingual (English and Malay) questionnaire was used to obtain information which consists of three parts: (A) Sociodemographic; (B) Awareness about repeatedly heating cooking oil; and (C) Practice of repeatedly heating cooking oil, as well as the type

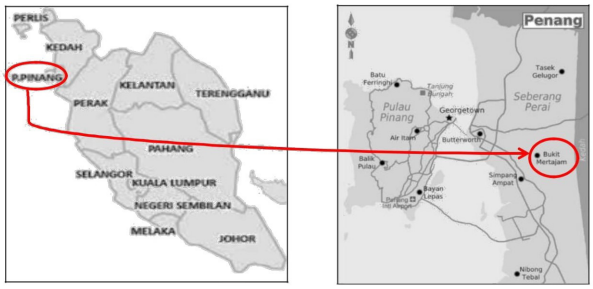

Figure 1: The map location of the study area (Seberang Perai Municipal Council, 2016)

and brand of cooking oil used in their business. The sociodemographic information obtained was gender, age, ethnicity, education level and monthly income. On the other hand, respondents' awareness on the peroxide content in cooking oil such as factors influencing quality of cooking oil, detection of peroxide in repetitively heated oil were assessed based on the nine items with three choices of answer: Agree, Disagree or Not Sure. A score of one was allocated for correctly replied on and zero score for incorrect or not sure answer. Then, the level of awareness was then classified into low (score 0 – 3), moderate (4 to 6) and high (7 to 9). As for the practice of using repeatedly heated cooking oils, information such as types of cooking oil used, types of food prepared which used the same repeatedly heated cooking oil and frequency of recycling the oil before discard it were obtained from the respondents.

Approval to conduct this research was obtained from the Universiti Putra Malaysia Ethics Committee (Ref no: UPM/TNCPI/RMC/1.4.18.2 (JKEUPM). The respondents were approached and their consent to participate was obtained prior to the data collection. All information was gathered via face-to face interview with the respondents based on the aforementioned structured questionnaire. All records collected become made anonymous, kept and controlled by way of the authors. Based on the responses obtained through questionnaire survey, five different brands of most popular cooking oil samples were purchased from the groceries within the study location and consisted of 1 litre (1L) of bottled and packaged palm oils. These oils were analysed for determination of peroxide at the Dietetics Laboratory at Faculty of Medicine and Health Sciences, UPM.

Data Analysis

All data obtained from the questionnaire were statistically analysed with the SPSS version 24. The descriptive statistics such as frequency, percentage, mean, standard deviation, and range were acquired to describe the data.

Measurement of Peroxide value in cooking oil

The fresh cooking oil samples undergone repeated heating procedure in the laboratory at temperature between 169 °C until 180 °C and was frozen at

temperature of -18 °C to -20 °C until analysis of samples was performed. Each sample was examined in triplicates to manipulate for the validity of the measurements and method used (10).The peroxide value in cooking oil was measured using iodometric titration with the reference from Cd 8-53 American Oil's Chemist Society (10).There were three main phases in the measurement of peroxide value. Firstly, the fresh oil was heated up to temperature of 160-180 °C. Then, +100 gram of potato slices were fried in a deep fryer with 500 mL of cooking oil for 3 to 5 minutes. Upon of completion of the frying session, the heated oil became accrued. For heating and frying procedures, both were conducted by using cooking oil from the previous session to represent practice of repetitively heating oil and followed by a cooling break for minimum of 180 minutes in between each session of frying procedure. Fresh oil was not being introduced between the frying procedures to make up for the loss due to uptake of the frying materials. For every session, an aliquot of oil (10ml) was taken from each brand of cooking oil for the extraction and measurement of the peroxide value (PV). All collected samples were kept in a separate dark-coloured bottle and stored at -18 to -20°C until analysis of PVs. The last stage in determining PV from oil samples was used to compare the calculated peroxide value obtained with the standard. The reference standard of 10meqO_2/kg was according to the American Oil Chemists Society (AOCS) become an indicator of deterioration for vegetable oils (10). Thereafter, the following equation was used to determine PV:

Peroxide Value (meq) = [Volume of thiosulphate titrate (ml) x Concentration of thiosulphate solution (N) x 1000] / Weight of sample (g)

As a precaution step during the experiment all samples were chilled and frozen until analysis of PV. While conducting the experiment, goggle, nitrile glove and laboratory coat were worn to avoid any contact and with the chemicals. Besides, the volume of samples collected must be sufficient to conduct the analysis and it was also a quality control in sampling analysis. Every containers and equipment used in the experiment was cleaned and labelled accordingly prior analysis.

RESULTS

Socio-demographic information

A total of 124 food handlers in food premise/ establishment in Bukit Mertajam, Penang were approached and enrolled voluntarily in the research. The age range for respondents involved in this study were between 18 to 65 year's old and almost 60% of them were below 45 years old. There were more female (66.5%) than male respondents participated in this study. Besides, more than half of the respondents were Malay (60.5%), meanwhile, for Indian and Chinese had contributed of 21.8% and 17.7% respectively. On top of that, as for the educational level, most of them received their formal education up to secondary school level (65.4%) and 53.2% of respondents with a month-to-month profits of much less than RM 2,500 participated in this study. Further information on the respondents' socio-demographic information can be seen in Table I.

Table I: The socio-demographic factors of respondents (N=124)

Variables	Frequency (%)	Mean (SD)	Range
Gender			
Male	44 (35.5)		
Female	80 (64.5)		
Age (Years)			
Below 45	73 (58.9)	36.2 (13.0)	18-65
45 and above	51 (41.1)		
Race			
Malay	75 (60.5)		
Chinese	22 (17.7)		
Indian	27 (21.8)		
Educational status			
Primary	37 (29.8)		
Secondary	80 (64.5)		
Tertiary	7 (5.6)		
Monthly income			
≤ RM 2,500	104 (83.9)		
≥ RM 2,501	20 (16.1)		

Awareness level of using repeatedly heating cooking oil
The frequency and percentage of respondents' awareness on the frequently heating oil is presented in Table II below. Moreover, the awareness scores of respondents were shown in Table III. In the present study, most of the respondents had moderate level (53.2%) of awareness on the use of repeatedly heating cooking oil.

Practice of using repeatedly heating cooking oil

The practice on repetitively heating oil by respondents is shown in Table IV while Table V illustrates the level of practice of repetitively heating oil among food handlers in this study. Almost half of respondents had moderate level of practice. Surprisingly, 43% of the respondents had bad practice on the use of repeatedly heating cooking oil and only 7% had good level of practice.

The peroxide value in repeatedly heated cooking oil

Table VI shows that the average peroxide value (PV) in the oil samples. The study found the PV started to exceed the standard at the 5th frying sessions, where the level increased gradually.

Table II: The frequency and percentage of awareness level using repeatedly heating cooking oil among respondents (N=124)

No.	Question	Frequency (%)
1	Peroxide presence can be detected in cooking oil especially if using repeatedly heating cooking oil?	
	Agree	47 (37.9)
	Disagree	50 (40.3)
	Not sure	27 (21.8)
2	If **"Agree"** (question no. 1), please state source of information obtained regarding on peroxide presence in cooking oil especially if using repeatedly heating cooking oil. (n=47)	
	Newspaper	6 (4.8)
	Magazine	5 (4.0)
	Television	3(2.4)
	Radio	10 (8.1)
	Internet	4 (3.2)
	Family/ Friends	19 (15.3)
3	Usage of repeatedly heating cooking oil for frying food is a good practice as it saves cost and there is no side effect.	
	Agree	39 (31.5)
	Disagree	55 (44.4)
	Not sure	30 (24.2)
4	The quality of oil used for frying will remain the same regardless of how many times the oil is reheated.	
	Agree	71 (57.3)
	Disagree	31 (25.0)
	Not sure	22 (17.7)
5	We can still use the same oil for many times and discard it only when it turns dark.	
	Agree	61 (49.2)
	Disagree	40 (32.3)
	Not sure	23 (18.5)
6	The frying duration influence types of by-products formation of repeatedly heating cooking oil.	
	Agree	68 (54.8)
	Disagree	22 (17.7)
	Not sure	34 (27.4)
7	The type of cooking oil does not influence the quality of the cooking oil.	
	Agree	61 (49.2)
	Disagree	43 (34.7)
	Not sure	20 (16.1)
8	Repeatedly heated cooking oil used for frying cause bad effects to human health	
	Agree	54 (43.5)
	Disagree	41 (33.1)
	Not sure	29 (23.4)
9	If **"Agree"**, to the above question (question no. 8) , what type of disease do they associate with the prolonged consumption of repeatedly heating cooking oil? (n=54)	
	Tuberculosis	3 (2.4)
	Food poisoning	13 (10.5)
	Hypertension	17 (13.7)
	Diabetes	1 (0.8)
	Cancer	20 (16.1)
10	What is the impact of high peroxide value in cooking oil?	
	Good quality of cooking oil.	11 (8.9)
	Bad quality of cooking oil.	49 (39.5)
	Handlers can still use and recycle the same cooking oil.	40 (32.3)
	Discard and replace used cooking oil with a new, fresh cooking oil.	24 (19.4)

Table III: The awareness level of using repeatedly heating cooking oil among respondents (N=124)

Variable	Level (Scores range)	Frequency (%)
Awareness in repeatedly heating cooking oil	Low (0-3)	42 (33.9)
	Moderate (4-6)	66 (53.2)
	High (7-9)	16 (12.9)

Table IV: The frequency and percentage of practice using repeatedly heating cooking oil in deep-frying among respondents (N=124)

No.	Question	Frequency (%)
1	Type of cooking oil's usage:	
	Palm oil	110 (88.7)
	Coconut Oil	1(0.8)
	Corn oil	5 (4.0)
	Olive oil	8 (6.5)
2	Do you use repeatedly heated cooking oil for cooking?	
	Yes	87 (70.2)
	No	37 (29.8)
3	If choose **"Yes"** (in Question 2) how many times is the same cooking oil being reused before discard it? (n=87)	
	1 time	37 (43.0)
	2 times	26 (29.9)
	3 times	14 (16.3)
	4 times	4 (4.7)
	5 to 8 times	6 (7.0)
4	If choose **"No"** (in Question 2) please state reason for not using repeatedly heating cooking oil? (n=37)	
	Harmful to health	8 (5.6)
	Cause food spoilage	12 (9.7)
	Increase cholesterol level in cooking oil	18 (14.5)
5	What is the food prepare using repeatedly heating cooking oil for cooking? (n=87)	
	Chicken	
	French fries	20 (19.4)
	Keropok lekor (fish cracker snack)	8 (7.3)
	Banana fritter	13 (9.7)
	Sweet potatoes	9 (9.7)
	Nugget or sausages	22 (23.4)
		15 (15.3)
6	Do you eat food that is not being sold out of your business?	
	Yes	73 (58.9)
	No	50 (40.3)
7	What is the method attempted to maintain quality of cooking oil?	
	– Use fresh cooking oil for cooking purpose every time	18 (14.5)
	– Maintain small flame while cooking process	30 (24.2)
	– Transfer oil in stainless steel or glass container after usage	43 (34.7)
	– Perform oil filtration to strain food particles or foreign matters in cooking oil	33 (26.6)
8	Please state source of information obtained regarding on usage of repeatedly heating cooking oil.	
	Newspaper	24 (19.4)
	Magazine	9 (7.3)
	Television	12 (9.7)
	Radio	12 (9.7)
	Internet	29 (23.4)
	Family/ Friends	19 (15.3)
	No prior information about this issue	19 (15.3)

Table V: The practice of using repeatedly heating cooking oil among respondents at Bukit Mertajam, Pulau Pinang (n=87)

Variable	Level	Frequency (%)	Range
Number of sessions in using repeatedly heated cooking oil	Bad	37 (43.0)	5 times or more
	Moderate	43 (50.0)	2-4 times
	Good	6 (7.0)	1 time

Table VI: The average peroxide value in repeatedly heated cooking oil with respective brands of cooking oils (N=5)

Total number of frying sessions by using the same cooking oil (times)	Average Peroxide Value (PV) with respective cooking oil's brands ($meqO_2/kg$)				
	A	B	C	D	E
Fresh cooking oil	3.6	1.2	2.0	1.2	1.8
1	5.2	3.8	2.6	2.0	3.2
3	7.0	5.8	7.2	3.0	5.4
5	9.8	9.4	12.0*	6.2	7.6
7	10.6*	10.0*	12.8*	8.0	8.2
9	12.0*	16.2*	15.8*	12.2*	11.0*

* Exceeds AOCS standard limit (PV ≥ 10 $meqO_2/kg$)

DISCUSSION

The interview revealed that majority of the respondent earned a monthly income of less than RM2,500 is because they just prepared a limited variation total of food items especially fried food in order to prevent any waste and loss in the business. This finding was also supported by Wai (2007) which emphasized on the limited variation of food products offered by the food operators operating a small-medium scale of business (11).

One of the aims of this research was to evaluate the awareness level regarding repeatedly heating cooking oil among sub-urban population in the study area. It is miles assumed that a sub-urban populace is more conscious and knowledgeable approximately health dilemmas in comparison to a rural populace (6). Thus, the respondents' awareness level concerning on the health issue could be seen as having an appropriate consciousness on the harmful effects especially on human health associated with continuous intake of continually oxidized fat/oil as part of daily diet of an individual.

Most of the respondents (40.3%) did not aware on the presence of peroxide, which can be detected in cooking oil mainly in repeatedly heated cooking oil. This finding could be explained based on the respondents' educational level which most of them were secondary school educated. According to Abdullah et al. (12), higher educated respondents were discovered to

have significantly more awareness concerning the usage of repeatedly heating cooking oil if compared to less educated respondents. Moreover, surprisingly up to 44.4% of respondents disagreed on the use of repetitively heating cooking oil during food preparation has no side effects in order to save cost. Based on the interview session, they claimed to be aware about the deleterious health effects such as cancer upon long-term consumption of oil being repeatedly heated. Ironically, they were still using the same cooking oil for several times before discarding it in order to reduce the production cost.

In addition, the respondents agreed that they could still reuse the same oil several times and remove it once the colour has changes into brownish (57.3%). This finding was in corresponded with a previous study (11) which stated that the food operators discarded the oils whenever seem to be necessary regardless on the duration and the whole number of cooking sessions allowed to ensure that cooking oil being used was in a good condition. Respondents also had a perception of re-using a high quality commercially popular brand of cooking oil especially bottled cooking oils has less impacts on health than the low quality of cooking oil.

Besides, nearly half of the respondents (53.2%) scored 4 to 6 out of total scores of 9 which indicated that majority of them were having moderate awareness level. Based on the survey, a moderate level of awareness among the food premise operators could be due to the lack of information and related knowledge on the harmful health effects and danger of prolonged consumption of rancid oil from the repeatedly heating process during food preparation. The sources of information are limited. Even some of the respondents admitted that they have no prior knowledge regarding this particular issue before. Despite that, many of them made an effort to maintain the quality of oil used for frying such as by maintain small flame in cooking process, transfer oil in stainless steel or glass container after usage and perform oil filtration to strain food particles or foreign matter in cooking oil due to the diverse motives especially to avoid food spoilage. Indeed, it is important to highlight the health impacts imposed by detection of high peroxide in cooking oil used by food premise handlers as they were part of the communities and being the responsible party who were preparing food products for consumers. Long-term uptake of foods cooked by the usage of rancid oil could significantly have an effect on antioxidant defence of an individual and potentially lead to diseases such as hypertension, diabetes and vascular inflammation (13). Nevertheless, there is still a gap that could be filled up in order to increase awareness on health issues associated with consumption of oxidised oils.

Half of the food handlers (50%) claimed using palm oil to prepare foods and discarded the oil after they had used it twice or even up to the fourth times (Table 5). This practice was not too bad because usage of palm oil in any food preparation is advisable as it could withstand thermal oxidation quite well (14). Those who used fresh oil for each frying session as they thought it was a healthy practice apart from it was able to improve the appearance of fried food. Besides, most of the food handlers interviewed (34.7%) claimed using chrome steel frying utensils which will keep the good-quality of oil during frying. This was a good exercise, as copper observed in brass and different copper alloy utensils can catalyse the thermal oxidation (15). The general public of respondents additionally maintained a small flame whilst frying, which became also a good application because at high temperatures cooking oil could decompose very quickly. The specific composition of palm oil permits it to resist heat higher than soybean oil. Palm oil is rich in saturated and monounsaturated fatty acids (MUFA) however, it has a lower degrees of polyunsaturated fatty acids (PUFA) compared to soybean oil (16). Vegetable oils high in PUFA are more inclined towards oxidation compared to those which high MUFA content. In fact, those oils are able to resist oxidation higher and formed much less degradation products on repetitive heating. There was a preceding study which has used potato slices to calculate degree of the oxidative balance of cooking oils, consisting of corn, palm and olive oil with deep frying (4).

Furthermore, Sivananthan et al. have expressed that deep frying became typically utilized in food preparation process especially for the frozen per-fried foods, snacks and fast meals (17). Deep frying process at a high temperature produces the unique flavour, golden brown and crunchy texture. It is far a truth that frying causes the oil to undergo hydrolysis, oxidation and thermal response and therefore several by-products are formed such as fatty acids, alcohols, cyclic compounds and polymers. This scenario might happen as the oxidation progresses will takes place based on the temperature, light, accessibility of oxygen in addition to the existence of humidity and metallic from utensils being used during frying. Oils with higher unsaturated fatty acids oxidized more quickly than oils with less unsaturated fatty acids (18).

This study found that the trend of PV was consistently increased in all tested samples. PV had increased with the increasing number of frying sessions. The increment of PV of the oils is due to the development of hydroperoxides of unsaturated fatty acids because of the lipid oxidation process. This study mainly focused on oxidation since it could cause undesirable flavours, disintegrating the dietary satisfactory as well as formation of toxic complexes. Oxidation of oils is influenced by means of different factors which include the degree of unsaturation, heat, light, oil processing, antioxidants and transition metals. The frequently reheating of cooking oil would eventually lead towards a greater risk to undergo the lipid peroxidation process (19). It is rather less

complicated to measure the peroxide value as compared to the direct measurement of odorants in cooking oils. Consequently, the peroxide value is importance for the evaluation of quality of meals particularly in oily, fried foods.

One of the strengths of this study was the ability to provide a baseline data related to the peroxide value in cooking oils particularly on repeatedly heating cooking oils since that there was limited studies focusing onto this issue. Apart from that, the level of awareness especially among communities could be enhanced by educating them on the accurate approaches with a view to preserve desirable quality of cooking oils. On the other hand, there have been a few drawback in this studies where this is a cross sectional study wherein the accuracy of statistics recorded were effective at the time survey was carried out. After a while, if the identical survey wants to be accomplished, some versions can be anticipated. For instance, the identical food operators might not be doing enterprise due to financial disaster or ill or loss of life or shift to do other business. A cross sectional study is a snapshot of conditions present at that instant. Inclusion of more participants will produce a better result due to the greater explanation may be amassed to create a tangible deduction regarding to the repetitively heated cooking oil. At some stage in face-to-face interview session, facts that obtained from the food premise handlers may additionally genuine and may not due to the fact they think that issues possibly will get up for his/her commercial enterprise if responded undesirably and they will change their responses for that second. There have been several factors which could have an effect on the quality of oil at some stage in the deep frying method, along with the varieties of food being fried, composition of the oils used, frying temperature, duration of frying time, use of a continuous or intermittent frying method and replenishment of clean oil.

As for the improvements for upcoming studies, there are a few other assessments that could be performed to assess the quality of cooking oil in spite of peroxide detection. For instance, by analyse the parameter of anisidine value, saponification value, iodine value and total polar compound (TPC). All these assessments involved laboratory analysis. However, there are also other methods in assessing quality of cooking oil used such as by observing the viscosity, colour, foam height and odour. The physical changes could be easily identified even for non-expert which may be helpful in making a decision to discard the frying oil used by the food handlers. In a nutshell, more proactive steps and actions can be taken to alleviate awareness on deleterious health impacts resulting from consumption of rancid oil to human. Related governmental institutions and organizations are encourage to publicly promoting and sharing relevant knowledge to the food handlers such as by using one-to-one approach to educate them. Aside from these, organizations and communities ought to play a role in spreading the facts to family, friends and circle of relatives' individuals. These spread of expressions might be a viral if every last bit of us is aware on those impacts of ingesting repetitively heated oil. These steps may aid to create a safer pattern of practice in using cooking oil repeatedly which fit for human's consumption.

CONCLUSION

Majority of respondents had moderate in both for the awareness (53.2%) and practice (63.7%) regarding repeatedly heating cooking oil. Based on the calculated average peroxide value (PV), most of the cooking oil samples had exceeded the standard limit prescribed in American Oils' Chemist Society (AOCS) standard of 10.0 meqO2/kg at the seventh and ninth frying sessions except for cooking oil (Brand C) which has already recorded PV of 12.0 meqO2/kg even as early as during the fifth frying sessions. There was room for improvement to alleviate the knowledge and awareness among the respondents regarding the presence of peroxide in food products particularly in deep-fried food. It was also important to allow them to know the permissible limit allocated for peroxide in which fit for human consumption. For instance, some approach could be applied to enable adequate knowledge and information regarding this little-known issue towards the food premise handlers such as by providing more publicity from the mass media. Other than that, a one-to-one individual sharing should be provided along with the awareness campaign focusing on food safety aspects.

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