UNIVERSITI PUTRA MALAYSIA

LEVEL OF KNOWLEDGE AND PRACTICE OF FRIED CHICKEN OPERATORS UNDER KAJANG MUNICIPAL COUNCIL REGARDING OIL QUALITY AND DETERMINATION OF PEROXIDE VALUE IN REPEATEDLY HEATED COOKING OIL

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BY

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ABSTRACT

LEVEL OF KNOWLEDGE AND PRACTICE OF FRIED CHICKEN OPERATORS UNDER KAJANG MUNICIPAL COUNCIL REGARDING OIL QUALITY AND DETERMINATION OF PEROXIDE VALUE IN REPEATEDLY HEATED COOKING OIL

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Introduction: Deep frying using repeatedly heated cooking oil is a well-known practice among night marketers locally. Deep-fried food intake from repeatedly heating cooking oil can adversely affect the health as 14-22% of oil were absorbed in the food batter. **Objectives:** This study aimed to determine the level of knowledge and practice of fried chicken operators under Kajang Municipal Council regarding oil quality and determination of peroxide value in repeatedly heated cooking oil. **Method:** A cross-sectional study was conducted in night markets under Kajang Municipal Council in January 2019. There were 123 fried chicken operators participated in this study and were interviewed by using a set of pre-tested questionnaire. The questionnaire consisted of three sections which covered questions related to sociodemographic in which covered questions related to gender, age and educational level as well as knowledge and practice of repeatedly heated cooking oil. A total of 100ml of used oil were collected from each respondent who participated in this study to be analysed for peroxide value using American Oil Chemist Society (AOCS) Cd 8b-90 Method. **Result:** There were 73 males and 50 females with age ranged between 20-58 (mean±SD = 35.1±9.7) years old involved in this study. Majority (73%) of the respondents obtained education up to secondary school level (*Sijil Pelajaran Malaysia*). Most of respondents had good knowledge (89%). However, 76% of them had poor practice on the usage of repeatedly heated cooking oil. Majority (68%) of respondents stated that the price of the cooking oil influenced this poor practiced. Most of the oil samples (84%) collected from the respondents showed the peroxide value which exceeded the AOCS standard of 10 mEqO2/kg. The result showed significant association between poor practice on repeatedly heated cooking oil and high value of peroxide in the oil samples (x^2=54.1, p=0.001). However, no such association observed between knowledge and practice. **Conclusion**: In conclusion, it is important to limit the practice of repeatedly heating cooking oil in food preparation in order to maintain the good quality of the food product. A proper and well plan program is needed to educate and improve the practice of the fried chicken operators in order to assure the quality of the food.

Keywords: Night Market, Knowledge, Practice, Peroxide Value, Titration

ABSTRAK

TAHAP PENGETAHUAN DAN AMALAN PENGENDALI AYAM GORENG TENTANG PENGGUNAAN MINYAK MASAK DI BAWAH MAJLIS PERBANDARAN KAJANG DAN PENENTUAN NILAI PEROKSIDA DI DALAM MINYAK YANG DIPANASKAN BERULANG KALI

SYED LUQMAN HAKIM SYED MOHAMMAD ZAHOOR

Pengenalan: Penggorengan menggunakan minyak masak yang dipanaskan berulang kali adalah amalan yang biasa diamalkan di kalangan pengusaha pasar malam tempatan. Pengambilan makanan digoreng dari minyak masak yang dipanaskan berulang kali boleh memberi kesan buruk kepada kesihatan kerana 14-22% minyak diserap dalam adunan makanan. **Objektif**: Kajian ini bertujuan untuk menentukan tahap pengetahuan dan amalan pengusaha ayam goreng di bawah Majlis Perbandaran Kajang tentang kualiti minyak masak dan penentuan nilai peroksida dalam minyak masak yang dipanaskan berulang kali. **Kaedah**: Kajian keratan-rentas telah dijalankan di pasar malam di bawah Majlis Perbandaran Kajang pada Januari 2019. Terdapat 123 pengusaha ayam goreng yang terlibat dalam kajian ini dan telah ditemuduga dengan menggunakan satu set borang soal selidik yang telah diuji dengan pra-ujian. Borang soal selidik ini terbahagi kepada tiga bahagian yang meliputi soalan-soalan yang berkaitan dengan sosiodemografi yang meliputi soalan yang berkaitan dengan jantina, umur dan tahap pendidikan serta pengetahuan dan amalan minyak goreng yang berulang kali. Sejumlah 100ml minyak dikumpulkan dari setiap responden yang mengambil bahagian dalam kajian ini untuk dianalisis nilai peroksida menggunakan Kaedah *American Oil Chemist Society* (AOCS) Cd 8b-90. **Keputusan**: Terdapat 73 lelaki dan 50 wanita dengan umur antara 20-58 (min ± SD = 35.1 ± 9.7) tahun terlibat dalam kajian ini. Majoriti (73%) responden memperoleh pendidikan sehingga ke peringkat sekolah menengah (Sijil Pelajaran Malaysia). Kebanyakan responden mempunyai pengetahuan yang baik (89%). Walau bagaimanapun, 76% daripada mereka mempunyai amalan yang tidak baik terhadap penggunaan minyak masak berulang kali. Majoriti (68%) responden menyatakan bahawa harga minyak goreng mempengaruhi praktik yang buruk ini. Kebanyakan sampel minyak (84%) yang dikumpulkan dari responden menunjukkan nilai peroksida yang melebihi standard AOCS 10 mEqO2 / kg. Hasilnya menunjukkan hubungan yang ketara antara amalan yang lemah pada minyak masak yang dipanaskan berulang kali dan nilai peroksida yang tinggi dalam sampel minyak ($x2 = 54.1$, $p = 0.001$). Walau bagaimanapun, tiada hubungkait diperhatikan antara pengetahuan dan amalan. **Kesimpulan**: Sebagai kesimpulan, adalah penting untuk mengehadkan amalan pemanasan minyak masak berulang kali dalam penyediaan makanan untuk mengekalkan kualiti produk makanan yang baik. Pelan program yang sesuai dan baik diperlukan untuk mendidik dan meningkatkan amalan pengusaha ayam goreng untuk memastikan kualiti makanan.

Kata Kunci: Pasar Malam, Pengetahuan, Amalan, Nilai Peroksida, Penitratan

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LIST OF ABBREVATIONS

AOCS	American Oil Chemist Society
ROS	Reactive Oxygen Species
PV	Peroxide Value
meq/kg	Miliequivalents of oxygen per kilogram
CVD	Cardiovascular disease
CHPD	Conjugated hydroperoxidiene

CHAPTER 1

INTRODUCTION

1.1 Background

Frying is one of the oldest food preparation methods. It is a dehydration process involving two rapidly heating and mass transfer components when the food dropped in hot oil at the temperature between 150^{0}C and 190^{0}C above the boiling point of water (Haizam & Razali, 2014). Deep fried food has desirable flavour, crispy texture, and brown colour that increases the food attractiveness among consumers. Despite to reduce the operational cost, whether commercial or individual repeatedly heated the same cooking oil and became as practiced (Kien & Tiu, 2017).

After several times heating, repeated heated cooking oil affects the oil's physical and chemical properties. It changes the oil's appearance, such as increased viscosity, colour darkening, foaming, and oil smoke point decrease. Rather, it also affects the taste of the food itself from frying time, food surface area, food moisture content, types of breading or battering materials, and frying oil affects the amount of oil absorbed in food (Moreira et al., 1997). During frying, the accumulation of

absorbed oil on the fried food surface tends to move into the food during cooling (Moreira et al., 1997).

During repeatedly heated cooking oil, the complex chemical reactions lead to hydrolysis, oxidation, and polymerisation of the oil, producing volatile or non-volatile compounds. Some of the volatile compounds will undergo additional chemical reactions or be absorbed in fried food and most of them will evaporate with steam in the atmosphere. (Choe & Min, 2007). Cooking oil that degrades changes the physical chemistry of the oil and should be discarded, as recent studies have shown that it is harmful to human consumption (Azman et al., 2012). Physical and chemical characteristics of a non-volatile compound that affect the stability, the taste and the texture of the flavour (Sunisa et al.,2011). Heated cooking oil can produce components that not only influence the quality of food but also cause compounds to form and have adverse food effects and potentially hazardous consequences for human health. (Sanibal & Mancini-Filho, 2004).

Fried chicken is very popular with locals and visitors in Malaysia. Due to high demands from fried chicken lovers in Malaysia, there are various types of fried chicken sold in Malaysia from local operators to an international company that invests their product in Malaysia, *ie*. Korean, American, and Swedish Company. Most fried chicken operators use the simplest frying method consisting of gas flames placed directly against the frying kettle's bottom. The recipe, frying condition and practice among fried chicken operators may vary. Due to the increasing price of

frying oil and chicken, the fried chicken operators tend to use full capabilities of the oil until it was no longer suitable to be used (Sunisa et al.,2011).

1.2 Problem Statement

There are various fried foods consumed in Malaysian such as starch-based, protein-based, and vegetable-based food. This research focuses on fried chicken as it is the preference globally and greatly accepted by Malaysian (Jayaraman et. al., 2013). Chicken meat is one of the most consumed foods in Malaysia in both rural and urban areas (Norimah et al.,2008). Statistically, the uptrend in chicken meat consumption from 36 kg to 39 kg per capita was shown between 2000 and 2011. The meat's versatility, low cost compared to other meat, acceptance of chicken meat to all religious, and household income increase are reasons that contribute to increased chicken meat consumption.

It came into concern that recent studies conducted generally on all types of fried food and measure the by-product of lipid peroxidation. This study only focussing only on the oil of fried chicken that repeatedly heated. Repeatedly heated cooking oil of fried chicken indicated the deterioration of oil on increasing of peroxide value is significant at ($p<0.05$) when continuous heating for 15,18, and 21 minutes (Sunisa et al.,2011). The problem statement from this research is that fried chicken operators practice repeatedly heated cooking whether they practice intermittent or continuous deep frying.

The storage of repeated cooking oil can also affect the peroxide value (PV) in the cooking oil, as air and moisture can react during cooling. A past paper published found that during storage of repeatedly heated cooking oil PV increased progressively in all samples except stored at 67^0C (Guillermo et. al., 1999).

1.3 Research Justifications

The purpose of this study is to determine the level of knowledge and practice of fried chicken operators on repeatedly heated cooking oil producing lipid peroxidation that undergoes complex chemical reactions producing by-products such as aldehyde, hydroperoxide and peroxide. This study focuses only on fried chicken operators. Fried chicken consumed almost every day by the majority of Malaysian. So, if everyone consumes fried chicken every day it will increase the burden of disease on non-communicable disease as high level of peroxide may contribute to cardiovascular disease and hypertension.

This study provided evidence of the current knowledge level and practice of fried chicken operators are good, intermediate, or low level. From this study, government agencies such as District Health Office can do some health promotion and intervention programs in the future to increase knowledge level among night marketers.

This study will provide information on the safe limit of cooking oil to be used specifically for chicken frying. This study also tends to raise awareness among fried chicken operators about the safe practice of repeatedly heated cooking oil with concern for chemical and physical properties in order to avoid harmful effects on consumer health.

1.4 Objectives

1.4.1 General Objectives

To determine the level of knowledge and practice of fried chicken operators under Kajang Municipal Council regarding oil quality and determination of peroxide value in repeatedly heated cooking oil.

1.4.2 Specific Objectives

i. To determine the sociodemographic among respondents.

ii. To determine the level of knowledge of repeatedly heated cooking oil among respondents.

iii. To determine the practice on repeatedly heated cooking oil among respondents.

iv. To associate the peroxide value in repeatedly heated oil sample and compare with the standard value of peroxide.

v. To associate sociodemographic and knowledge level on repeatedly heated cooking oil among respondents

vi. To associate sociodemographic and practice on repeatedly heated cooking oil among respondents

vii. To associate between knowledge and practice of respondent on repeatedly heated cooking oil among respondents

viii. To associate knowledge level with peroxide value of repeatedly heated cooking oil among respondents.

ix. To associate the practice with peroxide value of repeatedly heated cooking oil among respondents.

1.5 Hypothesis

i. There is a significant difference between obtained peroxide value with AOCS standard.

ii. There is an association between educational level and level of knowledge on repeatedly heated cooking oil among respondents

iii. There is an association between income and level of practice on repeatedly heated cooking oil among respondents.

iv. There is an association between level of knowledge and practice on repeatedly heated cooking oil among respondents.

v. There is an association between level of knowledge and peroxide value on repeatedly heated cooking oil among respondents

vi. There is an association between practice and peroxide value on repeatedly heated cooking oil among respondents.

1.6 Definition of Term

1.6.1 Conceptual Definition

i. Fried Chicken Operators

Any person who directly operates packaging or unpackaged food, food equipment and utensils, or food contact surfaces and is therefore expected to fulfill the requirement for food hygiene to serve food based on chicken for human consumption.

ii. Knowledge

Facts, information, and skills acquired through experience or training; a subject's theoretical or practical understanding. ("Knowledge", 2017)

iii. Practice

In contrast to the theories related to it, the actual application or use of an idea, belief, or method. ("Practice", 2017)

iv. Fried Chicken

Fried chicken is a dish made up of pieces of chicken, usually from broiler chickens that have been floured or battered and then pan-fried, deep fried or fried. Crisp well-seasoned skin is a hallmark of well-made fried chicken, rendered with excess fat.

v. Peroxide Value

Peroxide value is a value of hydroperoxide form due to primary oxidation of the cooking oil. Generally, good quality cooking oil has a lower PV.

vi. Cooking Oil

Plant, animal or synthetic fat used to fry, bake and other cooking methods. Cooking oil is commonly a liquid at room temperature, and during food preparation it acts as an important thing.

vii. Repeatedly Heated Cooking Oil

Deep-frying is a process of cooking that immerses water containing food in edible oil or fats at temperatures between 140 and 180 °C. The reuse of oil until fresh oil is discarded and replaced. Fats and oils have a high heat capacity, allowing heat transfer at a temperature far above the boiling water point.

viii. Socio-demographic factors

The term "sociodemographic" refers to a group defined by its characteristics of sociology and demography. Sociodemographic groups are used in social sciences for analyses. Demographic characteristics may refer to age, gender, place of residence, level of education, marital status, total income, and status of employment. Sociological features are more objective features, such as organizational membership, household status, interests, values, and social groups.

1.6.2 Operational Definition

i. Fried Chicken Operators

Fried chicken operators are the study sample which operates in MPKJ's night markets and will be chosen who sell fried chicken and aged 18 years old and above.

ii. Knowledge

Knowledge is defined as justified true belief. If there is evidence for a belief, it can be said as the belief is known (Plato, 2015). Food handler's knowledge will be assessed on the repeatedly heating cooking oil in this study.

iii. Practice

The practice is also described as doing or perform something habitually or repeatedly. The food handlers should know the correct practice of the deep-frying and avoiding the oil to be repeatedly heating.

iv. Fried chicken

Fried chicken that is marinated with certain spice for few hours before it soaked in flour and egg or in spice before deep-frying in optimum temperature at 160^0C to 180^0C

v. Cooking Oil

In this study, fried chicken operators operating in Kajang Municipal Council will collect the cooking oil. The cooking oil will be analysed through iodometric titration in the lab so that peroxide value can be determined.

vi. Peroxide Value

The peroxide value is determined by using a peroxide to measure the iodine released from potassium iodide using the titrant solution of sodium thiosulfate. The value of peroxide is expressed as thousands of peroxide equivalents per kg of oil. The measurement was repeated to obtain a triplicate measurement using the other oil sample.

vii. Repeatedly Heated Cooking Oil

The oil that heated repeatedly will be the sample in this study that obtained by fried chicken operators in the Kajang Municipal Council's night market and undergo iodometric titration to determine the peroxide value in it.

viii. Socio-demographic factors

In this study, the socio-demographic factors being studied which included respondents ' age, educational level, and monthly income.

1.7 Conceptual Frameworks

Malaysia is one country that is well known on their street foods. Even Malaysia is nominated as the heaven of food in Asia. These street foods operators usually gathered on specific time by their own municipal area that called night market. Night market in Malaysia sells various types of food that have their own unique taste and appearance. Fried chicken is street food that widely sells in night markets. Fried chicken is a protein-based food which has high popularity as there is no religion that restricts consumption of chicken.

Fried chicken is a food that uses deep-frying method to cook it. Nowadays, current economic status that is not good gives impact to the cost of raw ingredients and cost of living. Therefore, fried chicken operators' tendencies to practice repeatedly heated cooking oil are increased. Fried chicken operators ' knowledge level has influenced the practice of fried chicken operators to heat the cooking oil repeatedly to save costs. Repeated in heated cooking oil produces a by-product that causes harmful effects such as chronic disease on human health. The appearance of by-product varies according to several factors, i.e. temperature, packaging, cooking oil type, and oil duration.

Aldehyde, fatty acid, alkenal concentration, peroxide value, and iodine level are the by-product produced by repeated in heated cooking oil. In this study, the pollutant of concern is peroxide value as it shows the cooking oil's deterioration. Consumers who have the high-peroxide chronic intake of fried chicken may affect their health status with non-communicable chronic diseases such as obesity, diabetes, high blood pressure, atherosclerosis, and cancer. Figure 1.6.1 shows the conceptual frameworks of this study.

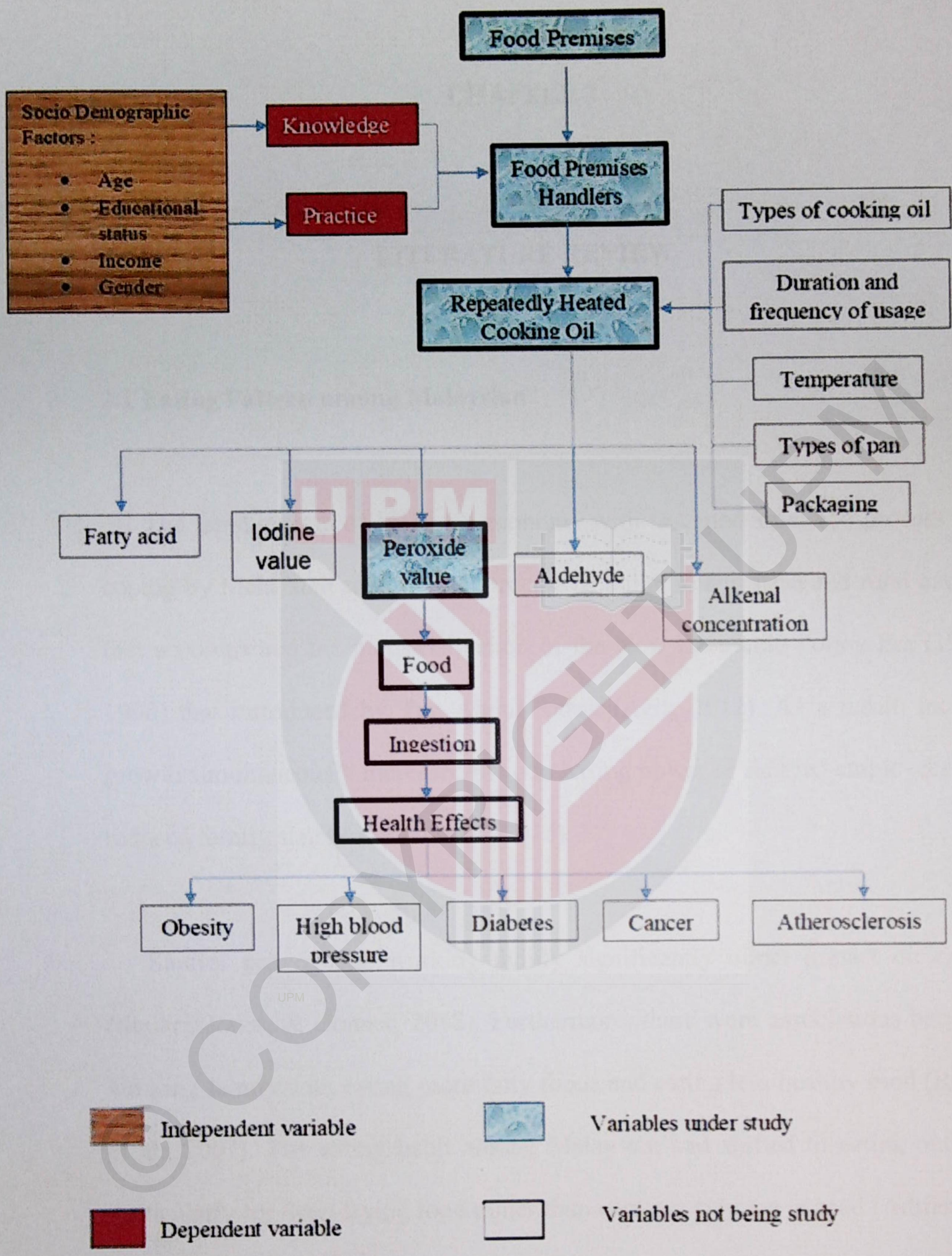

Figure 1.6.1: Conceptual Framework

CHAPTER 2

LITERATURE REVIEW

2.1 Eating Pattern among Malaysian

The rapid growth of Malaysia economy with fast modernization process was coping by Malaysian society. The process of rapid urbanization and rural exodus that accompanied the industrialization of the New Economic Policy Era (1971-1990) that introduced by Tun Abdul Razak (Aziz, 2012). As a result, income growth simultaneously increased the purchasing power of salaried employees and reduced family size (Fournier et al., 2016).

Studies proved that working family significantly direct impact on eating (Shukri, Jones, & Conner, 2018). Furthermore, there were associations between working family with eating more fatty foods and eating less healthy food (Roose et al., 2007). The eating habit among Malaysian had shifted to eating outside, particularly for deep-frying food rather than cooking at home instead (Adriana et. al., 2018). However, eating outside frequency was only high in the urban area with 55% of urbanities eating outside compare to 30% in the rural population (MANS, 2014). In fact, unhealthy food was tending to be cheaper than healthy

food which will give implication on habitual of eating (Kakoschke, Kemps & Tiggemann, 2017). Previous studies mentioned that consumption of fried food highly popular due to its availability as an example night market (Ali & Abdullah, 2012).

2.2 Cooking Oil

Oils and fats from edible vegetables oil were constituted of many foods, have nutrition and play important of organoleptic roles. Oils are formed of structure from esters of long-chain carboxylic acids. In lipid, oil part of saponifiable groups (contain an esters group). Lipids are biologically created materials that are relatively insoluble in water, but soluble in organic solvents that are polar and non-polar. A balanced proportion of fatty acyl chains in the diet have primary importance in human health and attributed to certain fatty acids. It also depends on the length of the chain and the degree of unsaturation (Andersson et. al. 2010)

Edible oils are a very important component of our daily diet that provides energy, essential fatty acids and serves as a carrier of fat-soluble vitamins (Zahir et al., 2016). Cooking oil is usually a liquid at room temperature, although some oils containing saturated fat are solid, such as coconut oil, palm oil, palm kernel, and nut oil. There are different types and brands of vegetable oils on the market where most claim to be free from cholesterol. Due to the increase in public

awareness of the health implications of high cholesterol in diets, most people now prefer to buy vegetable oils free of cholesterol (Attarde et. al. 2010).

Palm, oil, peanut oil, corn oil, and sunflower oil were used as cooking oil. Palm oil was used by a majority of Malaysians as their cooking oil. At present, Malaysia is the second world's largest palm oil producer and exporter (Azman et al., 2015). Palm oil acquired from the mesocarp *Elaeis guineensis* has good overall frying performance and thus contributes to its substantial use in deep frying applications. (Leong et al., 2011). Palm oil contained the higher saturated fats compared to other oil which able it withstands high temperature and heat of deep frying compared to highly unsaturated vegetable oil (Basiron et. al., 2007)

The main financial issue in fried food products is the price of oil, in which the oil bureaucracy forms part of the basic ingredients of a fried food product. Therefore, frequently the oil is repeatedly used to reduce the costs of meals preparation (Leong et al., 2011). In order to avoid using abused oil, bad health effects due to high consumption of fried foods in degraded oil, to maintain the quality of fried foods, to minimize the production costs associated with the early disposal of the frying medium, the quality of the oil must be observed (Vijayan et al., 1996). Oxidation activity caused by oil that may allow rapid degradation when rich with unsaturated fatty acids (Bou et al., 2012). The type of fried food, the type of oil used and the fryer design depended on the rate of formation of decomposition products for cooking oil (Azman et al., 2012). Recent studies have

shown that consumption of heating oil repeatedly has a harmful health effect in which it can cause increased blood pressure and cardiac tissue necrosis in the experimental rat (Leong et al., 2008).

Different types of physical and chemical parameters of edible oils can determine the compositional and deteriorating quality of oils (Mousavi et al., 2012). The physiochemical parameters may include peroxide value (PV), viscosity, density, saponification value (SV), iodine value (IV) (Osawa et. al.,2007). These techniques help to evaluate changes in the quality of the oil.

2.3 Palm Oil

Malaysia was the second largest palm oil producer and exporter after Indonesia, with palm oil originating in West Africa and spreading throughout the tropical regions and becoming a major crop in Malaysia. The palm tree was originally planted as an ornamental plant back then and has now become the world's highest vegetable oil consumption with 64 million tons or 35% of the world's total consumption of edible oil (Statista, 2017). Palm olein is an extract from the fraction of palm oil which is commonly used as a frying oil. Its frying oil has the same ratio of saturated and unsaturated fatty acids as it removes high melting point triacylglycerols and enriches lower melting point compounds. The melting point of palm olein (22–24 °C) is, therefore, lower than palm oil. (Matthäus, 2007).

During frying, food is immersed in hot oil at a high temperature (150–190°C), resulting in a set of chemical reactions such as oxidation, hydrolysis and polymerization degrading the oil (Esposto et al., 2015). Palm oil has low polyunsaturated fatty acid (PUFA) levels that are easy to oxidize and form toxic compounds during repeatedly heated cooking oil and have implications for human health. Next, even after exposure to thermal, palm oil has the ability to maintain vitamin E quality. As a result, palm oil is a more favorable option compared to soy and maize oil because of its chemical benefits and low consumption costs, particularly in Malaysia (Kamsiah & Yusof, 2012)

2.4 Repeated In Heating of Cooking Oil

Cooking oil is basically a liquid at room temperature, although some oil, such as coconut oil, palm oil, and palm kernel oil, is solid (Bandyopadhyay et al., 2017). In addition, cooking oil acts as a medium in frying where food immersed in hot oil and contact between oil, air and food at a high temperature between 150°C and 190°C (Choe & Min, 2007). To save costs, cooking oil is often heated repeatedly by either individual or food operators (Azman et. al., 2012). Repeated heating cooking oil was discarded only when the physical shape of it looks bad like foamy, emit a bad smell, or the appearance turns black (Phiri et. al., 2006). Statistics from the U.S. Department of Agriculture (USDA) showed that annual per capita consumption of cooking oils and salad oils rose from 26.6 lbs in 1993

to 33.7 lbs in 2002, while annual per capita consumption decreased from 25 lbs to 23.1 lbs in the United States during the same period (USDA, 2005).

During deep-frying processes such as oxidation, hydrolysis and thermal polymerization, a complex chemical reaction occurs (Steven et al., 1984). Oil performance and shelf-life act as a key indicator of fat and oils oxidation (Marina et al., 2013). Recent studies have shown that it is unhealthy to consume food fried with repeated heated cooking oil. During the drying of food, cooking oil is usually exposed to high temperatures for a long time. In addition, this practice generates lipid peroxidation and can harm human health (Lapointe et al., 2006). In the first stage, lipid peroxidation formed hydroperoxide, peroxides, and then peroxide polymers (Lupea, 2004).

2.5 Formation of Peroxide Compounds

The formation of peroxide through a process called oxidation in repeatedly heated cooking oil. The oil containing a high polyunsaturated level is going to oxidize more. Compared to saturated and monounsaturated, this is due to polyunsaturated prone to oxidation. By increasing viscosity, darkening the oil colour, spoiling its flavour, forming foam and lipid peroxidation, thermal reactions or repeatedly heated cooking oil will degrade the quality of the cooking oil.

Frying oil that causes water to initiate hydrolysis that vaporizes food. In vegetable oil, free fatty acids, monoaclyglycerides, diacylglycerides, and glycerol generation, the water vapors were broken down the oil chemical bond to ester bond of triacylglycerides. Hydrolysis acceleration rate rises due to product breakdown and from hydrolysis, glycerol increases free fatty acid formation.

Hydroperoxides produced from triacyclyceride oxidation that break down reactive free radicals to initiate reactions to autoxidation. The process of oxidation consisted of three main phases, initiation, propagation and termination.

Extreme heat may trigger the initiation phase during food preparation (reaction 2.5.1), resulting in formation of alkyl radicals (R). The initiation phase involves the splitting of hydrogen bonds, particularly those in α relative to the fatty acid chain of the double bond.

(2.5.1) $RH \rightarrow R\cdot + H\cdot$ (Initiation)

These alkyl radicals with an unpaired electron are highly unstable, short-lived intermediates that react to peroxyradicals quickly with triplet oxygen (ROO·; reaction 2.5.2).

(2.5.2) $R\cdot + {}^{3}O_2 \rightarrow ROO\cdot$

The peroxyradical then stabilizes to form hydroperoxide (ROOH) and another alkyl radical (R1·; reaction) by abstracting a hydrogen atom from another unsaturated fatty acid

(2.5.3). $$ROO\cdot + R_1H \rightarrow ROOH + R_1\cdot \text{ (Propagation)}$$

The resulting radical alkyl then replenishes reaction 2.5.2 and restarts it. Therefore, this radical reaction to the chain becomes "self-sustainable" and propagates at a high rate, which is the phase of propagation. During this phase, isomers of hydroperoxide are the major products. Propagation phases continue until the maximum hydroperoxide concentration increases the frequency of the collision between them. This stage marks the beginning of the termination phase, with hydroperoxides being decomposed into secondary non-radical oxidation compounds (reaction 2.5.4).

(2.5.4) $$ROO\cdot + ROO\cdot \rightarrow \text{nonradical compounds (Termination)}$$

The main hydroperoxide termination mechanism involves splitting the double bond adjacent to the hydroperoxyl group, decomposing into volatile hydrocarbons, aldehydes, alcohols, and ketones, as well as non-volatile secondary polar compounds such as non-volatile aldehydes, oxidized triacylglycerides, and triacylglyceride polymers. During the frying process volatile compounds produced by lipid peroxidation may be lost, the potentially

hazardous non-volatile polar compounds were deposited in the cooking oil (Moreira et al., 1999).

2.6 Peroxides Value (PV) Detection

There were several compounds that can be detected from repeatedly heating cooking oil which is aldehyde, total polar compounds, peroxide, alkenal concentration, and iodine value that can indicate the deterioration of deep-frying oil (Zahir et al., 2016). Of all the indicators, peroxide value has been selected as the indicator since it does not use any equipment to obtain the reading as a total polar compound that uses Testometer 207 to read (Sochor et al., 2017). In addition, the value of peroxide can be determined by using very practical iodometric titration for analysis. The recent study also found positive results in the deterioration of repeatedly heated cooking oil that peroxide value can be used as an indicator of oil degradation (Leong et al., 2011).

Peroxide value (PV) measures hydroperoxide formation, the process of lipid oxidation of unsaturated fatty acid formed as primary products by hydroperoxides (Haizam et al., 2016). Oil spoilage was based on the degree of oil rancidity caused by auto and PV can be assessed for photo-oxidation (Kaleem et al., 2015). The measurement can be used to evaluate the oils' quality. The recommended initial PV for cooking oil is less than 10 mequiv O2 kg-1 PV was used to measure repeatedly heated cooking oil oxidation due to the destruction of

hydroperoxides produced during primary oxidation at high temperatures and the formation of new peroxides during the cooling and storage process. Therefore, measurement of oil oxidation for p-AV is more reliable (Haizam et al.,2016)

2.7 Health Risks Associated with High Peroxide Presence in Cooking Oil

Several experts have found the harmful effects on human health of repeatedly heated cooking oil. Atoms and molecules produced by lipid peroxidation are very reactive because of the existence of an unpaired electron and therefore have an extra positive charge. The free radical must therefore react to another atom or molecule by stealing an electron in order to neutralize its own charge in order to achieve stability. By lipid peroxidation products, macromolecules such as DNA, protein, and lipid can react. A lipid peroxidation product reaction chain formed by macromolecules that made electron into lipid peroxidation products that damaged or became lipid peroxidation products (Halliwell & Gutteridge, 1999).

Non-communicable diseases such as pathogenesis of hypertension and atherosclerosis involve oxidative stress and lipid peroxidation (Libby et al., 2012; Mohler and Schafer, 2010). The cell membrane is made up of cholesterol and fats susceptible to free radical attack. Lipid peroxidation leading to an increase in serum cholesterol transportation and an increase in LDL-cholesterol. Atherosclerosis caused by increased blood artery volume of LDL and decreased atherosclerosis-protecting HDL-cholesterol (Kamisah et. al, 2018).

In short, fried food intake using repeatedly heated cooking oil will expose consumers to accelerated aging, increased levels of cholesterol, obesity, and weight gain. Prolonged consumption will increase the risk of cancer, diabetes, Alzheimer's disease, and atherosclerosis (Siti et. al., 2015)

2.8 Knowledge and Practice on Repeatedly Heated Cooking Oil

Based on a previous study, the safe level of oil to be heated was only once and not more (Kamsiah & Yusof, 2012). The act from the government do not seem serious on this issue as there is still no standard limit of peroxide value allowed in food.

Studies conducted in Kuala Lumpur showed that the level of knowledge among food operators was low on the repeatedly heating cooking oil as it costly to regularly exchange to new fresh oil when deep-frying (Azman et al., 2012). However, this study also stated that a few food handlers know on the effect of the repeatedly heating cooking as also it can reduce the cosmetic and taste of the food itself as the deterioration of oil affect food deep-fried. (Azman et al.,2012).

Knowledge on storage of heated cooking also low as oil that is heated and if it stored for later reuse must be kept appropriately to avoid further reaction during cooling of the oil (Guillermo et al., 1999). Awareness level on the public that consumed deep-fried food that is fried in repeatedly heated oil also is a matter of concerned as the public do not know the condition of the oil used to deep-fried the food (Azman et al., 2015).

CHAPTER 3

METHODOLOGY

3.1 Study Location

This study was conducted in the night market in Selangor which focuses under Kajang Municipal Council (MPKJ). Population in Kajang estimated to be 884,981(MPKJ, 2014). MPKJ cover several areas which are Kajang, Cheras, Semenyih, Beranang, Hulu Langat, and Hulu Semenyih. MPKJ was chosen as a study location as there was a total of 54-night markets under MPKJ. This study used convenience sampling because the list of fried chicken operators given by MPKJ does not tally with the numbers of fried chicken operators. The night market was chosen based on the highest density night market, distance from one to another, distance to be taken into the laboratory, resource, transportations, and sample will be chilled and freeze immediately until analysis. The map of study location is displayed in Figure 3.1.1

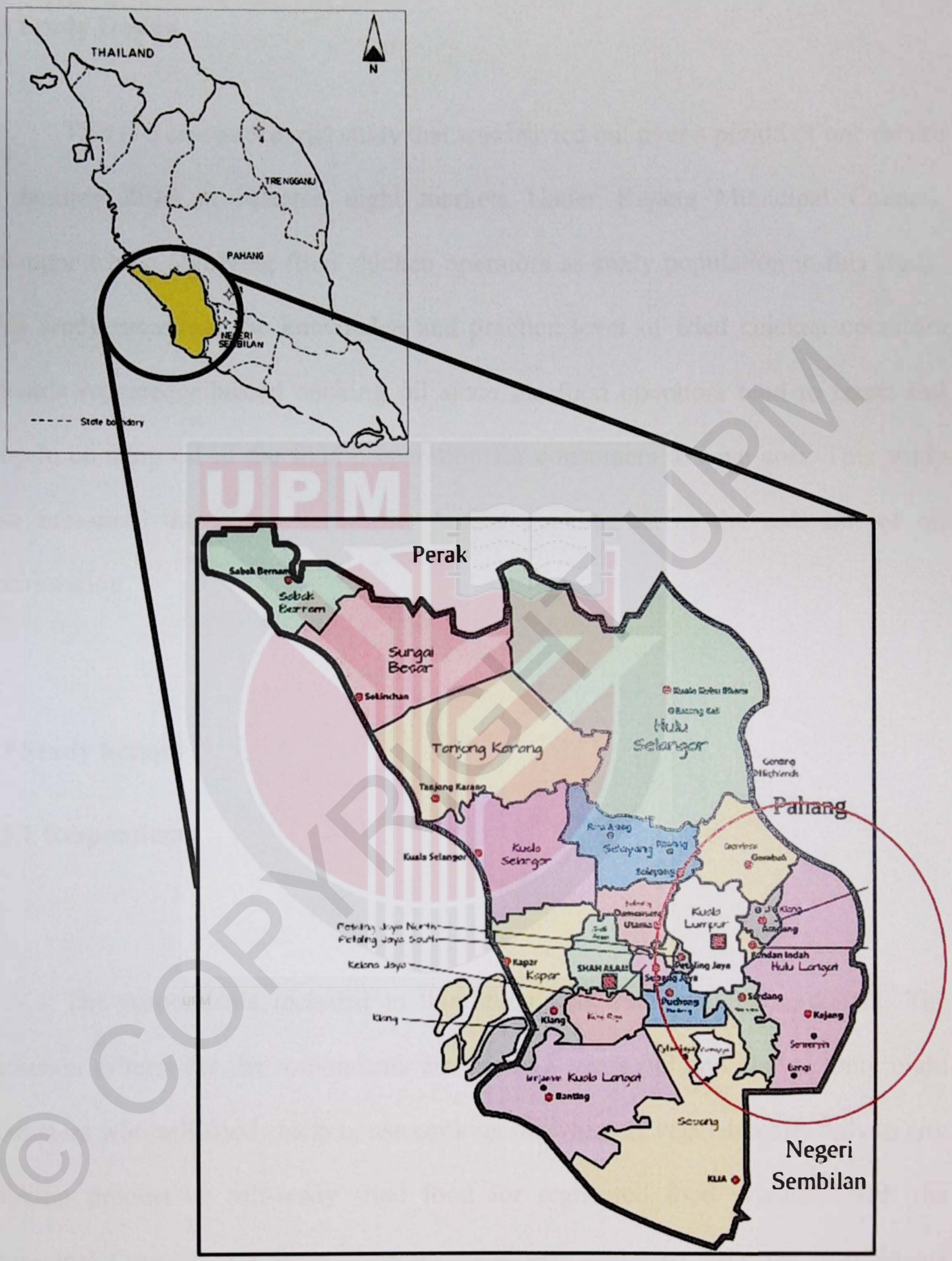

Figure 3.1.1: Map of Study Location

3.2 Study Design

This is a cross-sectional study that was carried out over a period of one month in January 2019 at selected night markets Under Kajang Municipal Council, Selangor which involving fried chicken operators as study population in this study. This study measured the knowledge and practice level of fried chicken operators towards repeatedly heated cooking oil since the food operators tend to reuse and recycle cooking oil in the food preparation for consumers to save cost. This study also measured the PV in repeatedly heated cooking oil as the indicator of oil deterioration.

3.3 Study Sample

3.3.1 Respondents

The respondents included in this study was among night marketers. The inclusion criteria for the respondents are aged 18 years old and above. Only night marketers who sell fried chicken, use cooking oil which is vegetable oils only in any cooking process or sell-ready fried food for registered food premises with the Municipal Council of Kajang. Relevant data were collected from the respondents focusing on the knowledge and practice of repeatedly heating oil among food premises handlers based on structured questionnaire through face to face interview.

Furthermore, the oil samples were collected from the respondent who were participated as respondents in this study.

3.3.2 Oil Samples

Oil samples were collected at the end of the day at the night market of Kajang Municipal Council. In order to measure the quality of oil sample, some other factors should be considered such as temperature, cooking utensils, type of oils and duration or the frequency of repeatedly using the same cooking oil. An exact 50ml of cooking oil was collected and placed in a dark single bottle. The oil was collected directly from the frying to prevent further chemical reaction during cooling.

3.4 Sampling Method

This study obtained respondents from a process which started from listing of 52-night markets under Kajang Municipal Council. However, list of fried chicken operators in Kajang Municipal Council list do not synchronize with actual list of fried chicken operators on the field. Hence, this study using convenience sampling and samples the night market from the densest to the less dense night market until reach the sample size of 123. This study comprised of respondents that only sell fried

chicken as the inclusive criteria. Respondents are chosen from night market under Kajang Municipals Council.

3.5 Sample size

The sample size was based on the calculation by (Lemeshow et. al.,1990) as shown below (Equation 1 and 2).

$$n = \frac{Z^2_{1-\alpha/2} P(1-P)}{d^2}$$ **Equation 1**

Where $Z^2_{1-\alpha/2}$ = z-score (1.96 for 95% confident interval)

P = Anticipated population proportion

(86.6% according to the Sivananthan et al., 2013)

d = Absolute precision required on the either side of the proportion

(Margin of error is ±5% or 0.05)

The calculation of estimated sample size:

$n = (1.96)^2 * 0.866 * (1-0.866)/(0.05)^2$

$= 3.8416 * 0.866 * 0.134/(0.0025)$

$= 0.3408 / 0.0025$

$= 178.32$

$=179$ respondents

Finite population correction factor.

$$n_a = \frac{n_r}{1+\frac{(n_r-1)}{N}}$$ **Equation 2**

Where n_a = The adjusted sample size

n_r = The original required sample size

N = Population size

$$n_a = \frac{178.32}{1+\frac{(178.32-1)}{213}}$$

$= 97.31$

$= 98$ respondents

Thus, to obtain a margin of error of plus or minus 5%, a total of 98 respondents requires in this study. However, after taking into consideration, an additional of 20% of the total respondents require to encounter non-responsive case and reject questionnaires sample.

$= 98 + [(98 \div 0.8) \times 0.2]$

$= 98 + 24.5$

$= 122.5$

$= 123$ respondents

Eventually, the minimum number of sample size is 123 respondents that need to participate in this study.

3.6 Data Collection and Instrumentation

3.6.1 Questionnaire

The questionnaire was written in Malay. The pre-test was conducted among fried chicken operators in UPM, (n=13) same characteristic with the study population. Some of the questions were modified based on the feedback obtain from the respondent from the pre-test.

The value of Cronbach alpha was 0.721. The actual survey was carried in January 2019. Study sample were approached and asked to voluntarily participate in this study. Based on the structured questionnaire the respondents were interviewed face-to-face. The questionnaire was divided into 3 sections, A, B, and C. In section A, it requires the respondent to provide socio-demographic data such as age, sex, race, marital status, income, educational level, and type of oil used for frying. Part B asked, the respondents about knowledge on the usage of repeatedly heating cooking oil, factors that altering the quality of frying, the effect of heating cooking oil repeatedly, and the peroxide that appears from repeatedly heating cooking oil. In Part C, the questions were designed to evaluate the practice on the usage of repeatedly heated cooking oil.

The answered questions were then scored for their knowledge and practice level. Each question that answered correctly were goven 1 score while 0 scores (nil) given if they answered incorrectly. The scoring range is illustrated in Table 3.6.1.1

Table 3.6.1.1: The Scoring Range for Knowledge and Practice

Category	Level	Range
Knowledge	High	6-7
	Moderate	3-5
	Low	0-2
Practice	Good	4-5
	Intermediate	2-3
	Poor	0-1

3.6.2 Peroxide Value Measurement

In order to determine the peroxide value of repeatedly heated cooking oil, an adequate amount of oil sample is needed. PV measurement involves 3 main steps which are collecting oil sample from the night market, analysing PV in the lab and compare PV results with the standards. The flow of the peroxide value measurement can be referred to in Figure 3.6.2.

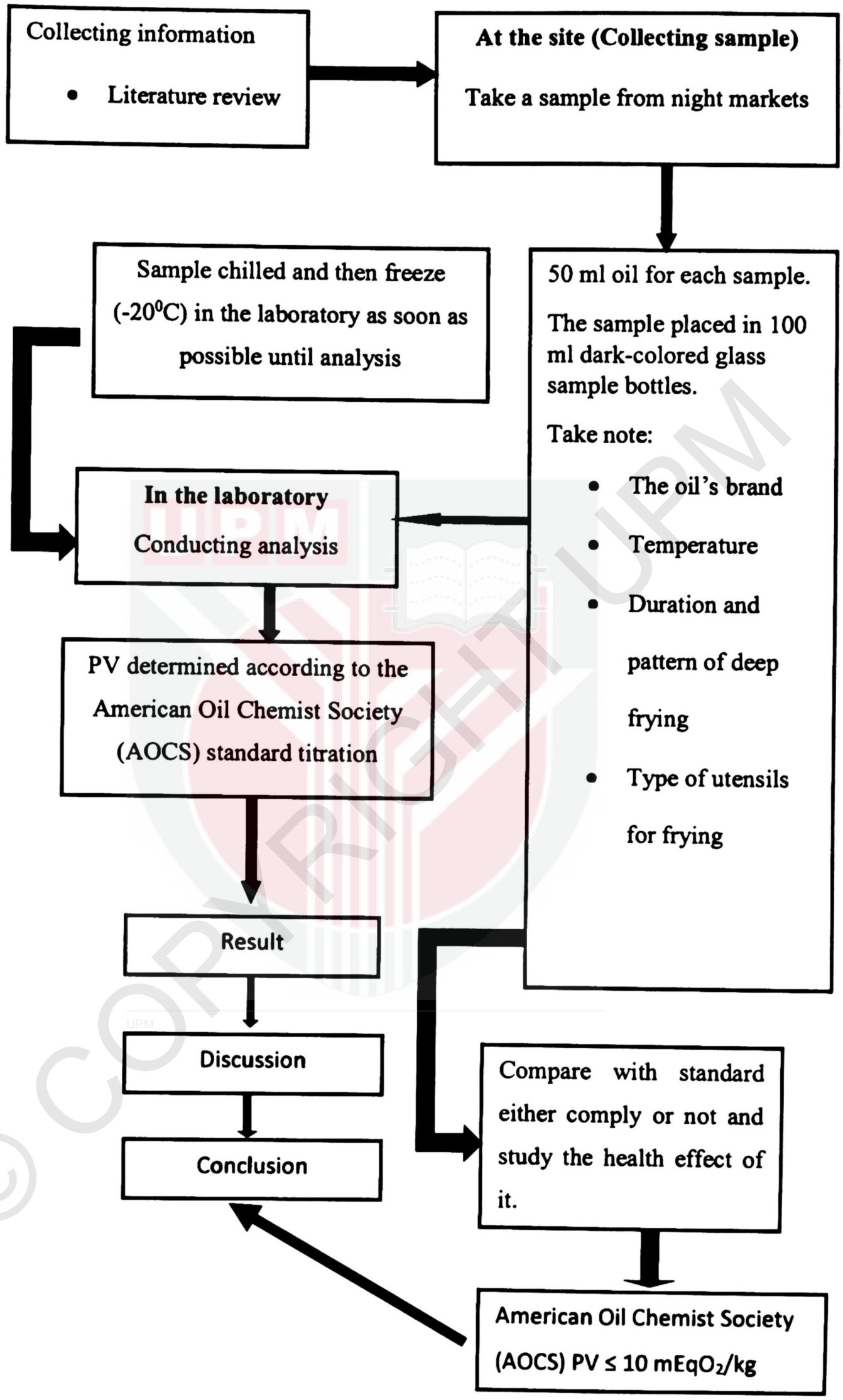

Figure 3.6.2.1: Lab analysis flowchart

1) Sample collection (collected during at the end of night marketer business around 10 pm)

- The volume of each oil sample collected at least 50 ml and the oil collect from each food outlet were stored individually in different 100 ml dark-coloured glass sample bottles.
- Take note on the brand of oil from different outlets, deep frying temperature, the duration of deep frying, deep frying pattern (continuous or intermittent), type of utensils used and either the outlet replenishes their oil during frying.
- Oil sample collected, then chilled, and stored (-20^{0}C) in the laboratory as soon as possible until analysis.

2) Laboratory analysis of PV

Oxidation of oil determined through Peroxide Value (PV). American Oil Chemist Society (AOCS) standard titration method used to analyses PV (Crowe& White, 2001). Peroxide value extends as milliequivalent of active oxygen per kilogram of oil sample, $mEqO_2/kg$. There were several compounds formed during oxidation and each of it has its own specific test. Hydroperoxides detected by changes of iodide to iodine by hydroperoxides. The quantitative measure of peroxides in the cooking oil given by the titre value from iodine formed by titrated with standard sodium thiosulphate solution (Rusell, n.d.).

i. Equipment

- 250 ml conical stoppered flasks
- 50 ml burette
- Balance
- Automatic pipette 1 ml
- Pasteur pipettes
- 25 ml measuring cylinder
- 100 ml measuring cylinder

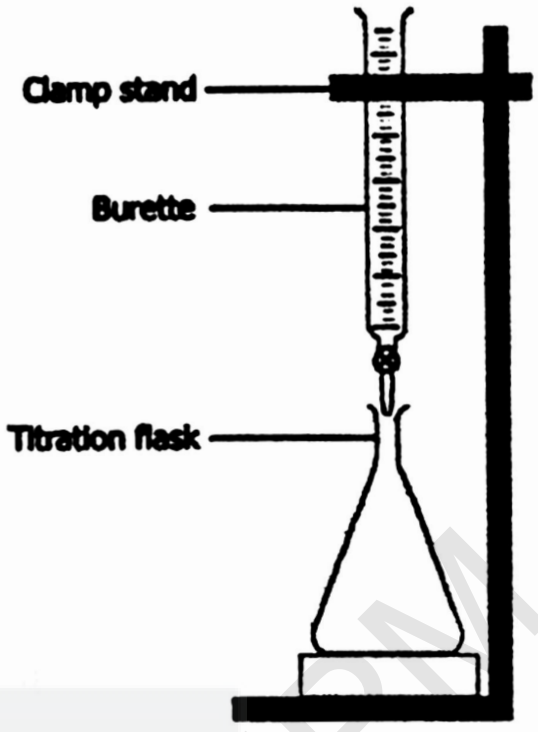

Figure 3.6.2.2: Titration

ii. Reagents

- Glacial Acetic acid-isooctane, 3:2 by volume
- Saturated potassium iodide solution (22 g KI + 11 ml water)
- 1% starch solution
- 0.1M sodium thiosulphate solution

iii. Method

- Firstly, 5g of oil was accurately weighted into stoppered 250 ml flask.
- Then, 25 ml acetic acid – isooctane solution and 1 ml of the saturated KI solution were added.
- Later, the flask was swirled and placed in the dark (in a cupboard) for exactly 1 minute.
- Then, 75 ml of water added (this stops the reaction).

- Next, a small amount of starch was added and titrated with 0.1M sodium thiosulphate solution, the flask vigorously being shaken, until the blue-black colour disappears.

iv. **Calculation of PV**

- Peroxide Value = (Vol of thiosulphate x M x 1000 / Weight of sample (g)
- The Peroxide Value is exposed as milliequivalent of peroxide per kg of oil. Milliequivalent (meq) = millimole.
- The measurement was repeated using the other sample of oil to obtain a triplicate measurement.

3) Compare with the standard

According to the American Oil Chemist Society (AOCS), the upper limit of PV for edible oil is 10 $mEqO_2/kg$.

3.7 Quality Control

3.7.1 Preservation and storage of cooking oil sample

Oil samples that collected during data collection should have all these elements which all the equipment and procedures appropriate to the matrix, the parameters to be analyse, and the sampling objective. A sample that collected must

be sufficient in term of volume of sample to perform the data analysis including quality assurance/quality control requirements. All sample containers cleaned and labelled appropriately. Furthermore, to maintain the quality of the sample the exterior of the sample containers was wiped and dried in sample packaging.

Sample bottle that used during collection was dark-coloured glass container to sustain hot cooking oil and to prevent any reaction prior to analysis. All information on the sample was recorded such as brands of oil used, frying temperature, duration of the deep-frying pattern (continuous or intermittent), do the operators replenish their oil during frying and type of utensils used for frying, and all the sample was labelled. Upon the analysis, the sample was chilled and froze (-20^{0}C) as soon as possible until analysis (Azman, et al., 2012).

3.7.2 Personal Protective Equipment

During data collection gloves were worn on a collection of hot cooking oil and aware of any splash of hot oil. During handling of samples in lab analysis, it was important to wear gloves, goggle, full laboratory coat, to prevent any splash or contact with the chemical. It was to ensure that there will be no contamination to the sample and can possibly give an error in reading.

3.8 Data Analysis

Data obtained from this study were analysed by using the software Statistical Package for Social Science (SPSS) version 25. The summary of the data analysis used in this study was in the tablev3.8.1 below. A p-value of 0.05 was considered as statistically significant.

Table 3.8.1: Summary of statistical analysis with respective specific objectives in this study

Objectives	Variables	Type of Data	Statistical Analysis
To determine the sociodemographic among respondents.	Age Gender Education	Categorical Continuous	Descriptive statistic (frequency and percentage)
To determine the level of knowledge of repeatedly heated cooking oil among respondents.	Level of knowledge.	Continuous	Descriptive statistic (frequency and percentage)
To determine the practice of repeated heating cooking oil among respondents.	Level of practice	Continuous	Descriptive statistic (frequency and percentage)
To determine the peroxide value in repeatedly heated oil sample and compare with the standard value of peroxide.	Peroxide value AOCs standard	Continuous	One sample T-test.
To determine sociodemographic and knowledge level on repeatedly heating cooking oil among respondents	Educational level Age Gender Level of knowledge	Continuous Categorical	Pearson Correlation Chi-square

To associate between socio-demographic and practice in repeatedly heated cooking oil among respondents.	Income Level of practice	Continuous Categorical	Pearson Correlation Chi-Square
To associate between the level of knowledge and practice in repeatedly heated cooking oil usage among respondents.	Level of knowledge Level of practice	Categorical	Chi-Square
To associate the level of knowledge and peroxide value among respondents.	Level of knowledge Peroxide value	Categorical	Chi-Square
To associate between practice and peroxide value on repeatedly heated cooking oil among respondents.	Level of practice Peroxide value	Categorical	Chi-Square

3.9 Ethical Consideration

Approval to conduct this research was obtained from the Universiti Putra Malaysia, Ethics Committee for Research Involving Human Subject (JKEUPM) (Ref no: UPM/TNCPI/RMC/1.4.18.2 (JKEUPM). The ethic approval letter was attached in the Appendix 1. The respondents were approached and prior to data collection, their consents to participate was obtained. All information was collected through a face-to-face interview with the respondents based on the structured questionnaire mentioned above. All collected record become anonymous, maintained and controlled by the researchers. A total of 100ml used oil was collected from each of the respondents and later were analysed in the Environmental Health Laboratory at Faculty of Medicine and Health Sciences, UPM for determination of peroxide value.

CHAPTER 4

RESULTS

4.1 Sociodemographic information of respondents among fried chicken operators

There were 123 respondents participated in this research and sociodemographic data of the respondent's age, education level, gender listed according to Night Market. All of the respondents were approached and enrolled voluntarily in this survey.

This study assessed the knowledge and practice level of the fried chicken operators as well as peroxide value in repeatedly heated cooking oil. Table 4.1.1 describes the socio-demographic information of respondents. The respondents aged between 20-58 years old. This research dominated by male with 59%. Majority of the respondents were educational level up to secondary school (73%) which granted them with the Malaysian Certificate of Education (Sijil Pelajaran Malaysia). Table 4.1.1 showed the sociodemographic data of the respondents

Table 4.1.1: The Sociodemographic factor of respondents (N=123)

Variables	Frequency (%)	Mean±SD	Range (Min-Max)
Gender			
Male	73 (59%)		
Female	50(41%)		
Age (years old)		35.1± 9.7	20-58
Educational Level			
Secondary	94 (76%)		
Tertiary	29 (24%)		

There was 10 Night Market chosen in order to complete this research. Pasar Malam Seksyen 16 contributed the most number respondent of 25 overall. The lowest peroxide value found in the samples was 2 $mEqO_2/kg$ from Pasar Malam Desa Jenaris while the highest was 67 $mEqO_2/kg$ from Pasar Malam Taman Delima. There were 103 out of 123 oil samples exceeded the Peroxide Value's Standard of AOCS. Kruskal-Wallis test was used to compare the PV value between night markets and there was no significant difference found. Table 4.1.2 showed the distribution of peroxide value in oil samples for all night markets involved.

Table 4.1.2: The frequency and percentage of Night Market and Peroxide Value of respondents (N=123)

Night Market	Sample Number (n)	Peroxide Value Min-Max	Peroxide Value Median (25th -75th)	Exceed AOCS (10 mEqO2/kg)	Kruskal-walis (df)	p-value
Pasar Malam Seksyen 16	25	3-59	14.6(12-22)	17		
Pasar Malam Desa Jenaris	15	2-41	14(11-24)	11		
Pasar Malam Taman Setia Sg.Chua	10	3-40	21.7(12-30)	8		
Pasar Malam Taman Kajang Perdana	15	2-36	14.6(12-21)	14		
Pasar Malam Kompleks Hentian Kajang	10	7-46	24(16-34)	9	13.4(9)	0.145
Pasar Malam Taman Delima	11	1-67	20.6(14-36)	11		
Pasar Malam Taman Bukit Mewah	14	3-60	19.6(14-32)	12		
Pasar Malam Kg. Baru Sg. Chua	8	4-27	21.3(14-26)	7		
Pasar Malam Taman Asa Jaya	7	12-34	21.4(14-28)	7		
Pasar Malam Taman Kenari	8	9-57	32.0(20-45)	7		
Total Night Market	123	2-67	4	103		

4.2 Knowledge on repeatedly heated cooking oil and peroxide

Table 4.3 presented the details on the knowledge level of respondents about repeatedly heated cooking oil and peroxide value. The results showed that the knowledge of the respondents regarding repeatedly heated cooking oil. The knowledge on peroxide value also showed a positive result as most (62.1%) of the respondents known that peroxide contains in the repeatedly heated cooking oil.

Furthermore, more than half of the respondents (63%) known as the peroxide contained in repeatedly heated cooking oil from the internet. It is showed the positive side of the internet where there was good information that spread to increase the awareness of the community about peroxide value. The description of frequency and percentage of respondents answered true, false and not sure for each question are shown in Table 4.2.1.

Table 4.2.1: The frequency and percentage of knowledge on repeatedly heated cooking oil (N=123)

	Question	Frequency (%)
1.	Usage of repeatedly heated cooking oil for frying food is a healthy practice	
	Yes	9(7.3%)
	No	107(86.3%)
	Not sure	7(5.6%)
2.	Usage of repeatedly heated cooking oil for frying food is good for saving cost.	
	Yes	12(9.7%)
	No	106(85.5%)
	Not sure	5(4%)
3.	Usage of repeatedly heated cooking oil for frying food has no side effect.	
	Yes	6(4.8%)
	No	112(90.3%)
	Not sure	5(4%)
4.	The quality of oil used for frying will remain the same regardless of how many times the oil is reheated.	
	Yes	4(3.2%)
	No	115(92.7%)
	Not sure	4(3.2%)
5.	We can use the oil for many times and discard it only when it turns darks.	
	Yes	7(5.6%)
	No	106(85.5%)
	Not sure	10(8.1%)
6.	There will be loss in nutrient in the repeatedly heated cooking oil used for frying.	
	Yes	85(68.5%)
	No	15(12.1%)
	Not sure	23(18.5%)
7.	The type of cooking oil does not influence the type of constituents produced from the repeatedly heated cooking oil.	
	Yes	50(40.3%)
	No	44(35.5%)
	Not sure	29(23.4%)
8.	Will repeatedly heated cooking oil used for frying cause bad effects to our health?	
	Yes	72(58.1%)
	No	27(21.8%)
	Not sure	24(19.4%)
9.	What type of disease associate with the consumption of repeatedly heated cooking oil?	
	Hypertension	3(2.4%)
	Cancer	120(96.8%)

Table 4.2.2 discussing the knowledge of respondents about peroxide value. More than half of the respondents know about peroxide (62.1%). The description of frequency and percentage of knowledge about peroxide value were shown in Table 4.2.2.

Table 4.2.2: The frequency and percentage of knowledge about peroxide among respondents (N=123)

No	Questions	Frequency (%)
1.	Do you know peroxide contains in the repeated heated cooking oil?	
	Yes	77(62.1%)
	No	46(37.1%)
2.	If answer yes, where the source information was obtained regarding the peroxide in the repeated heatedly cooking oil.	
	Newspaper	1(0.8%)
	Magazine	1(0.8%)
	Internet	78(62.9%)
	Never heard	42(33.9%)
3.	What happens if the peroxide values are high in the cooking oil?	
	The quality of the cooking oil good	36(29%)
	The quality of the cooking oil is bad	87(70.2%)
	Need to discard the oil and the use the new cooking oil	87(70.2%)
	Can still use the same cooking oil	36(29%)

4.3 Practice level of respondents on repeatedly heated cooking oil

Table 4.3.1 reported the details on the practice of respondents towards repeatedly heated cooking oil. Majority of respondents (75%) admitted that they practiced repeatedly heating cooking oil mostly due to the rise in the oil price. The respondents who do not practice repeatedly heated cooking oil's reason was that the food will look bad. Most of respondent's (68%) reasons practicing repeatedly heated cooking oil were the increasing of oil price. The description of frequency and percentage of respondents answered true, false and not sure for each question are shown in Table 4.3.1.

Table 4.3.1: The frequency and percentage of practice regarding the usage of repeatedly heated cooking oil among respondents (N=123)

No	Questions	Frequency (%)
1.	Do you use cooking oil repeatedly for frying?	
	Yes	93(75%)
	No	30(24.2%)
2.	Who answered "No" to the above question (question no. 1), what are the reason for not using repeatedly heated cooking oil for frying?	
	Harmful to health	
	Food will look bad	31(25%)
	Increase cooking oil's cholesterol level	
	Others	
3.	Who uses the same cooking oil repeatedly for frying how many times is the cooking oil reused before discarded?	

	≤1 time	40 (32.6%)
	2 times	34 (27.6%)
	3 times	29 (23.6%)
	4-10 times	20 (16.2%)
	Others	
4.	Why you do you repeatedly heated cooking oil	
	Oil price	84(68.3%)
	Food appearance	18(14.6%)
5.	Methods attempted to maintain the quality of cooking oil.	
	i) Using fresh oil for frying every time	
	Yes	110(88.7%)
	No	13(10.5%)
	ii) Maintaining a small flame while frying	
	Yes	106(85.5%)
	No	17(13.7%)
	iii) Using stainless steel frying utensil	
	Yes	
	No	116(93.5%)
	iv) Storing oil in stainless steel or glass container after usage	7(5.6%)
	Yes	
	No	106(85.5%)
	v) Filtering the oil to catch any food particles or foreign matter	17(13.7%)
	Yes	
	No	110(88.7%)
		13(10.5%)

4.4 Knowledge and practice on repeatedly heated cooking oil among respondents

Based on Table 4.4.1, the total scores of knowledge and practice for respondents was summed by given scores of one (1) for corrected answer question, and 0 for the opposite answer. The scores were categorised into 3 which is High, Moderate and Low (Azman et al., 2012).

The knowledge scores of respondents were sorted into 2 categories, Low to Moderate combined into 1 group as there is a low response on that category (0-8) and High (9-12). However, for knowledge Low to Moderate (0-4) and (5-7) for High level. Majority of the respondents (90%) have high knowledge regarding repeatedly heated cooking oil and having a poor practice of 87%. The scores were illustrated in Table 4.4.1 to assessed knowledge on repeatedly heated cooking oil.

Table 4.4.1: The knowledge and practice level of respondents on repeatedly heated cooking oil (N=123)

Variable	Median (25^{th}-75^{th})	Frequency (%)	Range
Knowledge			
Low to Moderate	10(8.7-9.6)	12 (9.8%)	0-8 scores
High		111 (90.2%)	9-12 scores
Peroxide			
Poor to Intermediate	4(3.4-3.9)	87(71%)	0-4 scores
Good		36(29%)	5-7 scores

4.5 The comparison between peroxide value with AOCS standards

Table 4.5.1 showed the comparison of peroxide value in oil sample with the standard value using One sample Wilcoxon Signed Rank Test. The result showed that the mean of the peroxide value in the study sample was significantly differenced from the standard ($p<0.001$).

Table 4.5.1: The comparison of Peroxide Value with AOCS Standards (N=123)

Variable	Median	Comparison Value	z	p
Peroxide Value	19.4	10	7.9	0.001**

***Significant at p<0.001*

4.6 The association between socio-demographic and level of knowledge

Table 4.6.1 showed associate between socio-demographic and level of knowledge. The association was made to determine either level of education and gender have a correlation with the level of knowledge. There was no association between education level and level of knowledge with chi-square ($x^2(1) = 0.056$) with $p=0.814$. The statistical data of chi-square were tabulated in Table 4.6.1.

Table 4.6.1: The Association between Socio-demographic and Level of Knowledge (N=123)

Variable	High	Low to Moderate	Total	x^2(df)	p
Education				0.056(1)	0.814
Secondary	84(89.4%)	10(10.6%)	94(100%)		
Tertiary	27(93.1%)	2(6.9%)	29(100%)		
Gender					
Male	66(90.4%)	7(9.6%)	73(100%)		
Female	45(90.0%)	5(10.0%)	50(100%)	0.001(1)	1.0

4.7 The association between socio-demographic and level of practice

Table 4.7.1 showed the association between socio-demographic and level of practice among respondents. The statistical analysis indicated that both education level and gender were not associated with the level of respondents' practice. The statistical analysis result as shown below.

Table 4.7.1: The Association between Socio-demographic and Level of Practice (N=123)

Variable	Poor to Intermediate	Good	Total	x^2(df)	p
Education				1.37(1)	0.242
Secondary	69(73.4.0%)	25(26.6%)	94(100%)		
Tertiary	25(86.2%)	4(13.8%)	29(100%)		
Gender					
Male	52(71.2%)	21(28.8%)	73(100%)		
Female	42(84.0%)	8(16.0%)	50(100%)	2.02(1)	0.115

The result in Table 4.7.2 indicated the association between age and peroxide value was also assessed. Age was not the factor that contributing to the increasing of peroxide value.

Table 4.7.2: The Association Between Socio-Demographic and Peroxide Value (N=123)

Variable	r	p
Age	0.034	0.093

4.8 Association between sociodemographic factors with a peroxide value

Table 4.8.1 assessed the association between education and gender with peroxide value. The results showed that both education and gender were not significantly associated with peroxide value.

Table 4.8.1: The Association Between Socio-demographic with Peroxide Value (N=123)

Variable	Not Exceed Peroxide Value <10	Exceed Peroxide Value ≥10	Total	x^2(df)	p
Education				0.15(1)	0.901
Secondary	16(17.0%)	78(83.0%)	94(100%)		
Tertiary	4(13.8%)	25(86.2%)	29(100%)		
Gender					
Male	14(19.2%)	59(80.8%)	73(100%)		
Female	6(12.0%)	44(88.0%)	50(100%)	0.66(1)	0.42

4.9 Association between Knowledge and Practice of respondents on repeatedly heated cooking oil

Table 4.9.1 displayed the association between knowledge and practice of respondents on repeatedly heated cooking oil. The result showed no significant association between knowledge and peroxide value.

Table 4.9.1: The Association Between Knowledge and Practice (N=123)

Knowledge	Practice		Total	x^2(df)	p
	Poor to Moderate	Good			
Low to Moderate	3(25.0%)	9(75.0%)	12(100%)	0.015(1)	0.903
High	85(76.6%)	26(23.4%)	111(100%)		

4.10 Association between Knowledge and Practice with Peroxide Value of Repeatedly Heated Cooking Oil

Table 4.10.1 showed the association between knowledge and practice with the peroxide value. The results showed that knowledge was not significantly associated with the peroxide value. On the other hand, the practice was significantly associated with peroxide value. It showed that among those with poor to moderate practice on repeatedly heated cooking oil, 98% of them used oil which contained high peroxide value level ($p<0.001$).

Table 4.10.1: The Association Between Knowledge and Peroxide Value (N=123)

Knowledge	Not Exceed Peroxide Value <10	Exceed Peroxide Value ≥10	Total	x^2(df)	p
Low to Moderate	3(25.0%)	9(75.0%)	12(100%)	0.2(1)	0.651
High	17(15.4%)	94(84.7%)	111(100%)		
Practice					
Poor to Moderate	2(2.1%)	92(97.9%)	94(100%)	54.16(1)	0.001**
Good	18(62.1%)	11(37.9%)	29(100%)		

***Significant at p<0.001*

CHAPTER 5

DISCUSSION, CONCLUSION, AND RECOMMENDATION

5.1 Discussion

5.1.1 Sociodemographic factors of respondents

This study was conducted to assess the level of knowledge and practice regarding repeatedly heated cooking oil amongst the fried chicken operators of night market under Kajang Municipal Council as well as to measure the peroxide value of repeatedly heated cooking oil used to fry the chicken. This population was interesting to study because they lived in the city which experiencing development and modernization. According to Azman et al., (2015), he assumed that the sub-urban population is more aware and knowledgeable about the health issues compared to a rural population. Therefore, the level of awareness of Kajang sub-urban food vendors regarding this little-known health issue can be seen as being representative of the knowledge of a typical suburban population of a developing country in South-East Asia. In total, 123 of respondents were surveyed. It was found in Table 4.1.1 that more than half of respondents were aged at ranged between 20-58 years (35.1±9.7) old because this is the productive age group (Fournier et. al., 2016).

5.1.2 Knowledge of respondents on repeatedly heated cooking oil and peroxide value

Level of knowledge and practice were assessed in this study. This study obtained that 90% of the respondents had good knowledge of repeatedly heated cooking oil. Compared to the previous study which had only 16% with high knowledge in Bukit Mertajam and 29% in Kuala Lumpur (Aziz et al., 2018; Azman et. al., 2012). The level of knowledge among food handlers from these 3 studies showed increment over time, when the level of knowledge already at a good level, it will be easier to conduct the program on improving the practice of fried chicken operators. Moreover, authority need to tackle certain factors that contributed to the unhealthy practice of repeatedly heated cooking oil (Azman et. al.,2012)

In addition, there were majority of respondents agreed that (86%) that usage of repeatedly heated cooking oil is not a healthy practice. More than half (68.5%) of the respondents know that there will be loss of nutrient of food when using repeatedly heated cooking oil food. Majority of them when asked what will repeatedly heated cooking oil will cause to health effect and 96.8% answered cancer. More than half (62.1%) of them knows what is peroxide that contains in repeatedly heated cooking oil.

Knowledge of oil properties and physicochemical really need to be taught to fried chicken operators. They used cooking oil almost every day and knowledge to keep the oil safe and, in the meantime, the proper way of handling used oil can be reduced the possibility of used oil to be further degraded. This knowledge should be included in the syllabus of fried food operators before they got their license. Furthermore, this action can educate and act as first-line defense from them to practicing their norm of repeatedly heated cooking oil.

5.1.3 Practice of respondents on repeatedly heated cooking oil

Level of practice on repeatedly heated cooking oil among respondents was really alarming. Majority (71%) of respondents had poor practice. Majority (75%) of respondents admit that they practiced repeatedly heated cooking oil. There were several factors contributing to these such as the type of chicken batter, oil package and frequency of oil repeatedly heated. The main factor that contributed to fried chicken operators to repeatedly heating cooking oil was not because of their low knowledge level but the economic situation. Increasing oil price suffers fried chicken operators. Moreover, more than half of respondents who have bad practice agreed that oil price was one of the factors influence their practiced.

On the other hand, the fried chicken operators who have good practice stated that they practicing good practice to maintain their taste and appearance quality due to some customers' demands. Customers will refuse to buy when they see the dark

coloured cooking oil. Cooking fried chicken with wet batter prone to darken more quickly compared to the dry batter. The color of oil was not indicated that the peroxide value was high in the fried chicken case. Even the first frying the oil already turning black (Sunisa et. al., 2011)

Previously, the past study focusing on all types of fried food among night marketers. This study focuses on only fried chicken operators and surprisingly there were high number of respondents practicing repeatedly heated cooking oil. With 82% of respondents have poor practice in repeatedly heated cooking oil. This percentage really need to be paid attention by the authority for further action in improving the poor practice of fried chicken operators.

The practice that already became a norm among night marketers and not only among fried chicken operators. However, there still a few of them who started to change the behavior and using the oil only once per day. They also used oil that pack in the bottle. Oil in a bottle having less peroxide than oil in a packet (Adriana et al., 2018). Some of them believe that using bottle oil have a longer duration. Hence, they can be used is for a week while packet only for 2-3 days. Even bottle oil quality is better than packet oil there is still a limit for the oil to be repeatedly heated. In a previous study, the peroxide started to exceed the AOCS standard at the 5^{th} cycle (Adriana et al., 2018).

Fried oil that was repeatedly heated must be stored in a proper container that do not expose to light or dark color bottle. Exposing used oil to light can further the alteration of the cooking oil and will increases the peroxide value (Matthäus, 2010). Most of the respondents who repeatedly heated the oil will filter their oil before storage and removing residue before and after storing it.

Long term ingestion of food prepared by using repeatedly heated cooking oil which compromises of several antioxidant defense networks lead to pathological problems such as hypertension, diabetes, and vascular inflammation. Oxidation of lipid possessed a high risk of development on coronary heart diseases (Bora & Rathore, 2015). All of the respondents using palm cooking oil (100%) for deep-frying purposes. Palm oil compared to other oil is one of the best for deep-frying because palm oil has the same ratio of saturated and unsaturated fatty acids. It has resulted from the triacylglycerols with high melting points were removed and compounds with lower melting points are enriched. Moreover, using palm oil as cooking oil produces better-fried food with a better mouthfeel without greasy sensation (Wong et al., 2019).

In addition, palm oil appears to be heat resistant compared to soy oil in terms repeatedly heated. Based on previous studies have suggested the composition of palm oil is unique allowing withstand heat better than soy oil. Firstly, the palm oil has a low proportion of polyunsaturated fatty acid (PUFA) compared to the soy oil

but the majority fatty acids form in palm oil are monounsaturated (MUFA) and saturated (Kamisah et al., 2018). Previous studies have shown that PUFA is more easily to oxidize compared to MUFA. Moreover, the result of toxic compound produced in the repeated heating of vegetable oil that rich in PUFA tend to increase the risk of hypertension, whereas the oils that rich in MUFA such as palm oil can be resistant to oxidation and formed fewer degradation products when heated (Soriguer et al., 2006). Secondly, palm oil is also rich in tocopherols and contains an abundant amount of tocotrienols (Kamisah et al., 2018). Tocotrienols have better antioxidants capacity compared to tocopherols. Thus, this may contribute to the better resistance to oxidative changes due to repeated heating of palm oil.

5.1.4 Sociodemographic factors with Knowledge and Practice of respondents

Knowledge and practice of a person can be associated with several factors. It includes income, gender, age, and educational background. Originally income of respondents was included as one of the studied factors of socio-demographic to correlate with the repeatedly heated cooking oil. Unfortunately, due to privacy and respondents not feeling comfortable to share their income information, the information was not available. Considering those factors, the income of respondents was excluded and only age, gender, and education level were assessed in this study.

After data collection and analyses of data, we found that there was no association between the socio-demographic factors with the knowledge or practice of

respondents on repeatedly heated cooking oil. The previous research also obtained the same result (Azman et. al.,2012). Knowledge and practice of respondents nowadays were influenced by the trends of media, internet and also issues arisen. They tend to know the issue of unsafe food due to repeatedly heated cooking oil when that issue went 'viral' in social media (Ahmed et. al.,2019).

5.1.5 Knowledge and Practice of respondents on repeatedly heated cooking oil

The score of knowledge and practice indicated that knowledge was already at a high level but unfortunately the practice level of the respondents was poor. There a study of human behavior explaining why the knowledge of human was high but still not practicing as their knowledge because of other factors that contributed to making them still practicing poor on repeatedly heated cooking oil. One of the factors contributed to this issue was because of oil price. The respondents told that every day they will get the lowest oil brand of the day (Ardichvilli et. al.,2019).

There was no significant association between the level of knowledge and practice of respondents on repeatedly heated cooking oil. From the result, the trend showed that respondents with low knowledge had good practice good and inversely. This means that knowledge does not resemble good practice on repeatedly heated cooking oil (Azman et. al., 2012).

Between knowledge and practice, the priority should be put more on the practice of respondents as the practice was significant to contribute unsafe oil that consumed by the customers. Simultaneously increasing the risk of cardiovascular disease, diabetes, hypertension and cancer (Jaarin, Masbah, & Kamisah, 2018). However, all of these factors have no significant with the practice of respondents. The habit of repeatedly heated cooking oil had become a norm among fried chicken operators and this bad practice was inherited to younger generation who started the business at night market also. Hence, they have used to the practice even knowing that this practice can give impact to health.

5.1.6 Knowledge and peroxide value of respondents on repeatedly heated cooking oil

There was no association between knowledge and peroxide value as the good knowledge did not show influence the quality of oil used by the respondents. Program to change the fried chicken operators practice need to be implemented and content of the program must not only focus on sharing awareness but enhance the safe practice of fried chicken operators.

5.1.7 Practice and peroxide value of respondents on repeatedly heated cooking oil

This study found that practice really plays important roles in determining the peroxide value of the repeatedly heated cooking oil as the increasing frequency of using the oil repeatedly will increase the peroxide value in the oil. Hence, practice were the strongest factors that contributing to unsafe cooking oil. Malaysian who lived in urban areas mostly were working family where they tend to buy food from outside due to the packed working schedule. Eating patterns also change and affect the prevalence of obesity. Eating fried food plus food with oil that repeatedly heated can increase the burden of disease among Malaysian (Fournier et al., 2016). When fried chicken operators practice poor in food preparation and exposed their food produce harmful substances such as peroxide value, this will contribute to the increase of chronic diseases related to unhealthy food consumption among the population.

5.1.8 Limitation of study

The limitation of this study is it using cross-sectional study design. Cross-sectional is a study that study in short period of time where measures exposure and outcome at the same period of time. This study has implications toward chronic health diseases. Hence, using cross-sectional study could not identify the sequence of events of dietary intake of fried chicken that using repeatedly heated cooking oil and the effects of health such as cardiovascular diseases. Furthermore, if further research conducted using same population. There will be changes of the fried chicken operators due to bankruptcy, migration, and change of business. Last but not least, was method of face-to-face interview. This method was used to ease the interview process as fried chicken operators was busy during operation. Unfortunately, it also causing the fried chicken operators to answered false positive as they afraid this research will affect their business.

5.2 Conclusion

This study was carried out to assesses the level of knowledge and practice of fried chicken operators under Kajang Municipal Council regarding oil quality and determination of peroxide value from repeatedly heated cooking oil. It was found that the majority of respondents having good knowledge of repeatedly heated cooking oil with 90% and the poor practice level among respondents was 76% that obtained based on questionnaires which conducted by face-to-face interview. The oil that obtained which analyzed in lab and peroxide value recorded was 84% of it exceeds the standard by American Oil Chemist Society. There was an association between level of practice and peroxide value with ($x^2(1) = 54$, $p=0.001$).

Overall, from this study, there was the improvement of knowledge among respondents from the previous study and room to alleviate improvement for the practice among fried chicken operators regarding repeatedly heated cooking oil. It was also important for this study to communicate their level of peroxide to respondents and increase their awareness of their current practice. This step will give respondents to know the permissible limit allocated for peroxide value which fit for human consumption. Last but not least, one-to-one individual sharing should be provided along with the awareness campaign focusing on food safety.

5.3 Recommendations for future research

For improvement of next research, oil quality not only can be assessed through the determination of peroxide value. There were other assessments that can be used to determine the deterioration of cooking oil. Assessment of analysing anisidine value, saponification value, iodine value and total polar compound (TPC). These assessments also require laboratory analysis to obtained result. By instance, there was a parameter by observation of the quality of the cooking oil. The parameters were viscosity, colour, foam height and odour. Physical changes can be used as detrimental for the deterioration of oil quality. It also makes helpful decision to discard the frying oil used by the food handlers.

In conclusion, there were many preventive steps that can be taken to reduce and change the current of fried chicken operators. Related government sector, Non-Government Organisation, and other organization are encouraged to help by sharing knowledge, budget, and implementation of the program on promoting to reduce the bad practice of repeatedly heated cooking oil.

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APPENDIX 1

ETHIC APPROVAL

ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA

Research title	:	**Level of Knowledge and Practice of Fried Chicken Operators in Kajang Municipal Council and Determination of Peroxide Value in Repeatedly Heated Cooking Oil**
Study Site	:	**Kajang**
JKEUPM Ref No.	:	**JKEUPM-2018-380**
Researcher	:	**Syed Luqman Hakim bin Syed Mohammad Zahoor**
Supervisor	:	**Dr. Saliza binti Mohd Elias**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 29/10/2018
2. Respondent Information Sheet & Consent (English), Version 1 dated 29/10/2018
3. Respondent Information Sheet & Consent (Malay), Version 3 dated 29/11/2018
4. Proposal (English), Version 1 dated 29/10/2018
5. Questionnaires/ Interviews (English), Version 1 dated 29/10/2018
6. Questionnaires/ Interviews (Malay), Version 1 dated 29/10/2018
7. Curriculum Vitac of:
    a. Dr. Saliza binti Mohd Elias
    b. Dr. Mohd Redzwan bin Sabran

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance to the ICH-GCP Guidelines.

Decision by JKEUPM:

[X] Approved

[X] **Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research**

[ ] Disapproved

Please note that the approval is **VALID UNTIL 6 DECEMBER 2019**

Researchers should comply with the following:

I. Complete a Study Final Report upon study completion (Form 3.2).

II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.

APPENDIX 2

QUESTIONNAIRE

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH,
FACULTY OF MEDICINE AND HEALTH SCIENCES,
UNIVERSITI PUTRA MALAYSIA, 43400 UPM
SERDANG, SELANGOR MALAYSIA

QUESTIONNAIRE / *SOAL SELIDIK*

TITILE: Level of Knowledge and Practice of Fried Chicken Operators in Kajang Municipal Council. and Determination of Peroxide Value in Repeatedly Heated Cooking Oil.

TAJUK KAJIAN: Tahap Pengetahuan dan Amalan Pengguna Makanan Bergoreng di bawah Majlis Perbandaran Kajang dan Penentuan Nilai Peroksida(Tengit) di dalam Minyak Masak yamg di Masak Berulang Kali.

Introduction: This study is aiming to assess the level of knowledge and practice of fried chicken operators Majlis Perbandaran Kajang and determination of peroxide value in repeatedly heated cooking Oil. Please give accurate information as required. All information provided will be used for research purpose only. Thank you for your cooperation

Pengenalan: Kajian ini bertujuan untuk menentukan tahap pengetahuan dan amalan pengendali ayam goreng di Majlis Perbandaran Kajang dan penentuan nilai peroksida(tengit) di dalam minyak masak yamg di masak berulang kali. Sila berikan maklumat yang tepat seperti dikehendaki. Semua maklumat yang diberikan akan digunakan untuk tujuan pengajian sahaja. Terima kasih atas kerjasama anda.

Respondent ID : _____

Responden ID

Date : _____

Tarikh

Part A : Demographic information

Bahagian A : Maklumat Demografi

Instruction: please fill in the blank and tick (√) where appropriate.

Arahan: Sila isikan tempat kosong dan tandakan (√) di mana sesuai.

1. Gender: Male/Female
   Jantina: Lelaki/Perempuan

2. Marital status: Single/Married
   Status Perkahwinan: Bujang/Berkahwin

3. Age (years old):
   Umur:

4. Race: Malay () Chinese () India () Others:
   Bangsa: Melayu () Cina () India () lain-lain:

5. Education status/ Status Pendidikan: No formal education ( ) UPSR ( )PMR/SRP ( ) SPM ( ) DEGREE ( ) MASTER ( ) PHD ( )

Food Operators Information/ *Maklumat Pengendali Makanan*:

1. Type of deep-fried food/ Jenis makanan bergoreng:

2. Cooking oil brands/Jenama minyak masak:

3. Cooking oil packaging/Bungkusan minyak masak: Bottle/Botol ( ) Packet/paket ( )

4. Types of oil used for frying/ Jenis minyak digunakan untuk menggoreng:
   Palm Oil/ Minyak kelapa sawit ( ) Peanut oil/ Minyak kekacang ( ) Corn oil/ Minyak jagung ( ) Soy oil/ Minyak soya ( ) Olive oil/ Minyak zaitun ( ) Coconut oil/ Minyak kelapa ( )
   Others/ lain-lain:_____

5. Income/ *Jumlah pendapatan* (RM):

6. Working Status/*Status Pekerjaan*: Full time/*Sepenuh Masa* ( ) Part time/*Sambilan*( )

   what/*apa*:_____

7. Temperature of oil/ Suhu minyak masak:_____

Part B : Respondent's knowledge on the usage of repeatedly heated cooking oil

Bahagian B : Pengetahuan responden mengenai penggunaan minyak masak yang dipanaskan berulang kali.

Instruction: Please fill in the blank and tick (√) where appropriate.

Arahan: Sila isikan tempat kosong dan tandakan (√) di mana sesuai.

1. Usage of repeatedly heated cooking oil for frying food is a healthy practice.
   Penggunaan minyak masak yang dipanaskan berulang kali untuk menggoreng makanan adalah amalan yang sihat.

   Yes/*Ya* ☐ No/*Tidak* ☐ Not sure/*Tidak pasti* ☐

2. Usage of repeatedly heated cooking oil for frying food is good for saving cost.
   Penggunaan minyak masak yang dipanaskan berulang kali untuk menggoreng makanan adalah bagus untuk penjimatan.

   Yes/*Ya* ☐ No/*Tidak* ☐ Not sure/*Tidak pasti* ☐

3. Usage of repeatedly heated cooking oil for frying food has no side effect.
   Penggunaan minyak masak yang dipanaskan berulang kali untuk menggoreng makanan tiada kesan sampingan.

   Yes/*Ya* ☐ No/*Tidak* ☐ Not sure/*Tidak pasti* ☐

4. The quality of oil used for frying will remain the same regardless of how many times the oil is reheated.
   Kualiti minyak tidak bergantung kepada kekerapan minyak dipanaskan.

   Yes/*Ya* ☐ No/*Tidak* ☐ Not sure/*Tidak pasti* ☐

5. We can use the oil for many times and discard it only when it turns darks.
   Kita boleh menggunakan minyak untuk banyak kali dan membuangnya hanya apabila ia bertukar gelap.

   Yes/*Ya* ☐ No/*Tidak* ☐ Not sure/*Tidak pasti* ☐

6. There will be loss in nutrient in the repeatedly heated cooking oil used for frying.
   Nutrien dalam makanan akan hilang apabila minyak masak yang dipanaskan berulang kali digunakan untuk menggoreng.

   Yes/*Ya* ☐ No/*Tidak* ☐ Not sure/*Tidak pasti* ☐

7. **The type of cooking oil does not influence the type of constituents produced from the repeatedly heated cooking oil.**
   Jenis minyak masak tidak mempengaruhi jenis produk sampingan yang dihasilkan daripada minyak masak yang dipanaskan berulang kali.

Yes/*Ya* ☐ **No/*Tidak*** ☐ **Not sure/*Tidak pasti*** ☐

8. **Will repeatedly heated cooking oil used for frying cause bad effects to our health?**
   Adakah minyak masak yang dipanaskan berulang kali untuk menggoreng akan membawa kesan buruk kepada kesihatan?

Yes/*Ya* ☐ **No/*Tidak*** ☐ **Not sure/*Tidak pasti*** ☐

Who answered "Ya" to the above question (question no. 8)/ *Bagi menjawab "ya" pada soalan di atas (soalan no. 8}.*

9. **What type of disease associate with the consumption of repeatedly heated cooking oil?**
   Apakah jenis penyakit yang berkaitan dengan penggunaan minyak masak yang dipanaskan berulang kali?

Gout/ *Gout* ☐

Tuberculosis/ *Batuk kering* ☐

Diabetes/ *Kencing manis* ☐

Hypertension/ *Darah tinggi* ☐

Cancer/ *Kanser* ☐

***you can choose more than one for this question.**
anda *boleh memilih lebih daripada satu untuk soalan ini.

Part C: Respondent's knowledge about peroxide

Bahagian C: Pengetahuan responden mengenai peroksida

Instruction: Fill in the blank and tick (√) where appropriate.

Arahan: Sila isikan tempat kosong dan tandakan (√) di mana sesuai.

1. **Do you know peroxide contain in the repeatedly heated cooking oil?**
   Adakah anda tahu dalam minyak masak yang dipanaskan berulangkali megnadungi peroksida?
   Yes/Ya ☐ **No/Tidak** ☐

2. **If yes, where you get the informations?**
   Jika ya, dimanakah anda mendapat maklumat tersebut?

   Newspaper/*Surat khabar* ☐ **Magazine/*Majalah*** ☐ **Television** ☐

   Radio ☐ **Internet** ☐ **Others/lain-lain :**_____

   ***you can choose more than one answers.**
   ***** anda *boleh memilih lebih daripada satu untuk soalan ini.*

3. **What will happen when peroxide values are high in the cooking oil?**
   Apakah yang akan terjadi bila kadar peroksida tinggi dalam minyak masak?

   The quality of cooking oil good. ☐
   Kualiti minyak masak bagus.

   The quality of cooking oil bad. ☐
   Kualiti minyak masak tidak bagus.

   Need to discard the oil and replace with new cooking oil ☐
   Perlu buang dan tukarkan minyak yang baru

   The oil is still can be used. ☐
   Minyak tersebut masih boleh digunakan.

   ***you can choose more than one answers.**
   ***** anda *boleh memilih lebih daripada satu untuk soalan ini..*

Yes/ya ☐ No/tidak ☐

**If yes how much? / Jika ya, berapa?* _____ °C

6. How many times the cooking oil is reused before discarded?
   Berapa kali anda menggunakan minyak tersebut sebelum anda membuangnya?
   2 times ☐ 3 times ☐ 4-10 times ☐ Others:_____
   2 kali *3 kali* *4-10 kali* *Lain-lain:*_____

7. Choose the methods to maintain the cooking oil quality:
   Pilih kaedah untuk mengekalkan kualiti minyak:

   a) Use fresh oil for every frying. Yes/Ya
   ☐
   Gunakan minyak masak yang baru setiap kali menggoreng. *No/Tidak*
   ☐

   b) Maintaining small flame during frying. Yes/Ya
   ☐
   Mengekalkan api kecil semasa menggoreng. No/Tidak
   ☐

   c) Using stainless steel utensil. Yes/Ya
   ☐
   Menggunakan perkakasan keluli tahan karat *No/Tidak*
   ☐

   d) Store cooking oil in stainless steel or glass container after used.
   Simpan minyak masak dalam keluli tahan karat atau bekas kaca selepas digunakan.

   Yes/Ya ☐ No/Tidak ☐

   e) Filter the cooking oil to catch any food leftover or foreign matter.
   Tapis minyak masak untuk menangkap sisa makanan atau bahan asing.

   Yes/Ya ☐ No/Tidak ☐

7. How you get the information regarding the peroxide in the repeatedly heated cooking oil?

Part D: Respondent's practice regarding the usage of repeatedly heated cooking oil

Bahagian D: Amalan mengenai penggunaan minyak masak yang dipanaskan berulang kali:

Instruction: Fill in the blank and tick (√) where appropriate.

Arahan: Sila isikan tempat kosong dan tandakan (√) di mana sesuai.

1. Do you use repeatedly heated cooking oil for frying?
   Adakah anda menggunakan minyak masak yang dipanaskan berulang kali untuk menggoreng?
   Yes/ya ☐ No/tidak ☐

   Who answered "No" to the above question (question no. 1),
   Siapa yang menjawab 'Tidak' untuk (soalan no. 1),

2. What are the reason for not use repeatedly heated cooking oil for frying?
   Apakah sebab tidak menggunakan minyak masak yang dipanaskan berulang kali untuk menggoreng?

   Harmful to health ☐ Food will look bad ☐
   Bahaya untuk kesihatan *Makanan akan kelihatan teruk*

   Increase cooking oil's cholesterol level ☐ Others ( )
   :_____
   Boleh meningkatkan kadar kolestrol dalam minyak *Lain ()*
   :_____

3. Do you add new oil after several times of frying? / Adakah anda menambah minyak baru setelah beberapa kali menggoreng?

   Yes/ya ☐ No/tidak ☐

   **If yes how many times? / Jika ya, berapa kali?* _____

4. How many times you change the oil during operation? / Berapa kali anda menukar minyak semasa berniaga? _____

5. Do you measure the temperature of the cooking oil during frying? / Adakah anda mengukur suhu minyak ketika menggoreng?

Bagaimanakah anda mendapat maklumat berkaitan peroksida yang terkandung dalam minyak masak yang dipanaskan berulang kali?

Newspaper/Surat khabar ☐ **Magazine/Majalah** ☐ **Television** ☐

Radio ☐ **Internet** ☐ **Others/lain-lain**
:_____

No prior knowledge about this issue ☐
Tiada sebarang pengetahuan mengenai isu ini

8. Would like to obtain more informations about the issue?

Adakah anda ingin mendapat maklumat yang lebih lanjut mengenai isu ini?

Yes/Ya ☐ **No/Tidak** ☐

Contact :_____

APPENDIX 3

CONSENT FORM

JAWATANKUASA ETIKA UNIVERSITI UNTUK PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR, MALAYSIA

BORANG 2.4: PENERANGAN DAN PERSETUJUAN RESPONDEN

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1.TAJUK KAJIAN

Tahap Pengetahuan dan Amalan Pengendali Ayam Goreng Tentang Penggunaan Minyak Masak di bawah Majlis Perbandaran Kajang dan Penentuan Nilai Peroksida Di Dalam Minyak yang Dipanaskan Berulang Kali

2. PENGENALAN

Minyak masak adalah suatu bahan yang penting dan perlu diambil perhatian yang serius dalam penyediaan makanan. Amalan memanaskan minyak untuk menggoreng makanan secara berulangkali adalah tidak selamat dan boleh membahayakan kesihatan pengguna makanan tersebut. Minyak diganti apabila sudah berbuih, mengeluarkan bau yang kurang menyenangkan, atau warnanya bertukar menjadi gelap. Pengambilan makanan yang disediakan daripada minyak yang dipanaskan berulang kali boleh meningkatkan risiko untuk pembentukan atherosclerosis (pemendapan plak di dalam pembuluh darah) dan juga berkaitan dengan peningkatan jumlah lemak dan lipoprotein berketumpatan rendah dalam darah. Ini akan meningkatan risiko mendapat penyakit jantung dan kanser.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Untuk menjayakan kajian ini:
1. Peserta akan ditemuramah oleh penyelidik untuk mengumpulkan maklumat latarbelakang, pengetahuan dan amalan berkaitan penggunaan minyak untuk menggoreng makanan.
2. Sampel minyak masak yang telah digunakan untuk menggoreng makanan akan diambil daripada setiap peserta sebanyak 50ml untuk dianalisis di makmal. Sampel minyak akan dianalisis untuk menentukan kandungan peroksida di dalam minyak tersebut.
3. Penyertaan peserta di dalam kajian ini adalah secara sukarela dan anda boleh menarik diri pada bila-bila masa sepanjang kajian dan tidak akan terkesan kepada lesen meniaga, dikompaun atau didenda jika anda tidak mengikuti kajian ini.
4. Tiada token akan diberikan kepada peserta.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Pengendali makanan yang tidak menjual ayam goreng dan tidak meniaga di pasar malam di bawah Majlis Perbandaran Kajang.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) **KEPADA ANDA SEBAGAI PESERTA?**
Ia akan membantu anda untuk meningkatkan pengetahuan berkenaan isu kesihatan berkaitan penggunaan minyak yang dipanaskan berulang kali dan

secara tidak langsung boleh membantu meningkatkan kesedaran berkenaan kesan merbahaya peroksida.

b) KEPADA PENYELIDIK?

Kajian ini akan dapat memberikan maklumat terkini berkenaan tahap pengetahuan dan amalan pengendali ayam goreng berkenaan peroksida di dalam minyak masak terpakai serta tahap kualiti minyak yang digunakan untuk menggoreng. Maklumat sedemikian akan membantu penyelidik dan pihak berkuasa dalam merangka program kesedaran dan promosi kesihatan yang berkaitan untuk meningkatkan kualiti kehidupan masyarakat.

6. ADAKAH IA BERISIKO?

Peserta yang menyertai kajian ini tidak terdedah kepada risiko kerana kajian ini tidak melibatkan pengumpulan sampel biologi seperti darah atau urin.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Semua informasi pengendali ayam goreng akan dirahsiakan dan dianggap sulit.

8. SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEMASA MENGIKUTI PENYELIDIKAN INI?

Sebarang pertanyaan boleh diajukan kepada Dr. Saliza Bt. Mohd Elias, Penyelia kajian di nombor 03-89472402 (emel: saliza_me@upm.edu.my) atau Syed Luqman Hakim Bin Syed Mohammad Zahoor, penyelidik di nombor 019-9203963 (emel: syedluqmanhakim96@gmail.com).

Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini _____

9. PERSETUJUAN

Saya..... No Kad Pengenalan. ..... beralamat..... .....dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam penyelidikan yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi, risiko dan komplikasi (seperti tertulis pada Helaian Penerangan Responden). Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang melibatkan saya.

I setuju/tidak bersetuju untuk imei/gambar/rakaman video/ rakaman suara digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

***potong yang tidak berkenaan**

Tandatangan ..... **Tandatangan .....**
(*Responden*) **(*Saksi*)**

Tarikh :..... **Nama :.....**

No. K/P: .....

Saya mengesahkan bahawa saya telah menerangkan kepada responden ini sifat dan tujuan penyelidikan yang tersebut di atas.

Tarikh ..... **Tandatangan .....**
(*Penyelidik*)

APPENDIX 4

IMAGE OF RESEARCH