For discussion
on 12 November 2019

LegCo Panel on Food Safety and Environmental Hygiene

Trade Guidelines on the Use of Deep-frying Oil

Purpose

This paper briefs Members on the "Trade Guidelines on the Use of Deep-frying Oil" (the Guidelines) published by the Centre for Food Safety (CFS) of the Food and Environmental Hygiene Department in October 2019.

Background

2. The Government conducted a public consultation in 2015 on the regulation of edible fats and oils, including the proposed regulation of metallic contaminants and harmful substances in edible fats and oils. During the public consultation, food traders expressed that reused oil or cooking oil in use should not be covered in the regulatory regime. The trade would like the Government to provide some guidelines on the safe use of deep-frying oil (e.g. when the oil had to be disposed of, etc.) for their reference and adoption.

3. In response to the trade's request, CFS commissioned the PolyU Technology and Consultancy Company Limited (Study Consultant) in September 2017 to conduct a study on the use of frying oil and formulate guidelines. The Guidelines (Annex I) have now been finalised. CFS held a seminar on 22 October 2019 to explain the Guidelines to the trade. The Guidelines have also been uploaded to CFS website for reference by the public.

Safety and Quality Standards of Edible Fats and Oils

4. During the public consultation conducted in 2015, the Government proposed to regulate metallic contaminants (arsenic and lead) and harmful substances (erucic acid, aflatoxins and benzo[a]pyrene) in edible fats and oils through legislative amendments. The proposal

involved amending two different subsidiary legislations under the Public Health and Municipal Services Ordinance (Cap. 132). We completed part of the legislative work last October which amended the Food Adulteration (Metallic Contamination) Regulations (Cap. 132V) to stipulate maximum levels for arsenic and lead in food such as edible fats and oils.

5. In addition, we are now drafting a legislative proposal to update the Harmful Substances in Food Regulations (Cap. 132AF). Maximum levels for industrially-produced trans fats and mycotoxins (including aflatoxins in food such as edible fats and oils), as well as for harmful substances like erucic acid and benzo[a]pyrene in edible fats and oils will be proposed to enhance protection of food safety. We plan to consult the public on the proposal next year.

6. We note that the safety standards for edible fats and oils in other economies generally apply to products for sale in the market (i.e. fresh oil or unused edible oil), rather than reused oil or cooking oil in use. At present, there is no international consensus on the safety standards of reused oil or cooking oil in use, and no relevant standards have been established by the Codex Alimentarius Commission. Our proposal to adopt total polar compounds (TPC) and/or acid value as quality indicator(s) for reused oil or cooking oil in use is in line with the general practice of other places.

Trade Guidelines on the Use of Deep-frying Oil

7. Chemical reactions occur in edible fats and oils during the deep-frying process. High temperature leads to heat reactions in deep-frying oil, and causes moisture in food to evaporate and release into the oil, resulting in hydrolysis. Also, oxygen in air causes deep-frying oil to oxidise. The Study Consultant of CFS took reference from relevant guidelines of different economies and conducted market surveys in Hong Kong. Based on the data and information obtained from the surveys, the Study Consultant conducted experiments mimicking the process of deep-frying food by local food premises, followed by chemical analyses on levels of benzo[a]pyrene, erucic acid, acid value, TPC, etc. in deep-frying oil.

8. Results of the experiments showed that benzo[a]pyrene and erucic acid levels in deep-frying oil did not increase with repeated use. Acid value and TPC of deep-frying oil steadily increased with the number of times the oil was used. Slower increasing rates were observed in

experiments using cooking oil with higher content of monounsaturated fatty acids (e.g. rapeseed oil) than that with higher content of polyunsaturated fatty acids (e.g. soybean oil), and thus the former is more suitable for deep-frying. Furthermore, the experiments showed that compared with food coated with batter, frying food without batter was more likely to affect the quality of deep-frying oil.

Trade Consultation

9. Based on the changes and results of the above parameters observed in the experiments mimicking the deep-frying process, the Study Consultant prepared the draft Guidelines which put forward specific recommendations and indicators for assessing quality of deep-frying oil (including colour, odour, smoke point, foaming, etc.) as well as the conditions under which the deep-frying oil should be changed. The Study Consultant consulted the trade (including chefs, managers and operators of food premises) extensively through a number of trade consultation meetings and field visits, and invited individual food premises to try out the recommendations in the Guidelines. During the consultation process, over 100 traders were involved in assessing the operability of and the trade's receptiveness to the draft Guidelines.

10. The traders consulted generally agreed that the recommendations in the Guidelines could be applied to daily operations and help improve the quality of deep-frying oil and deep-fried food. The Study Consultant also suitably incorporated suggestions from traders into the Guidelines to better meet the operational needs of the trade.

Further Promotion and Publicity Work

11. CFS has started to introduce and publicise the Guidelines widely to the trade. This includes organising trade seminars in different districts, explaining the Guidelines in detail to employees working in various types of catering premises (e.g. restaurants, factory canteens, residential homes, hospitals, etc.), and enhancing the trade's understanding of the Guidelines through CFS's electronic publications, social media platforms, website, etc., with a view to encouraging and facilitating their adoption of the recommendations therein. CFS will also produce booklets and posters (Annex II) on the recommendations on using deep-frying oil in the Guidelines for distributing to food premises in different districts, so as to facilitate the trade's use in their workplace.

12. CFS will review at suitable junctures the practice of using deep-frying oil by food premises, as well as the adoption and implementation of recommendations in the Guidelines by the trade.

Advice Sought

13. Members are invited to note the content of this paper.

Food and Health Bureau
Food and Environmental Hygiene Department
November 2019

Annex I

TRADE GUIDELINES

ON THE USE OF DEEP-FRYING OIL

The Hong Kong Polytechnic University 香港理工大學
FSTRC 食物安全及科技研究中心 Food Safety and Technology Research Centre
食物環境衞生署 Food and Environmental Hygiene Department
食物安全中心 Centre for Food Safety

Foreword

The Food Safety and Technology Research Centre of the Hong Kong Polytechnic University was commissioned by the Centre for Food Safety, Food and Environmental Hygiene Department to conduct a study on deep-frying oil and devise this set of Guidelines in order to assist local food traders in ensuring food safety and enhancing food quality.

Contents

Background

Deep-frying is one of the commonly used cooking methods.

During deep-frying, oil reacts with moisture in food and oxygen in air to form chemical compounds, such as polar compounds.

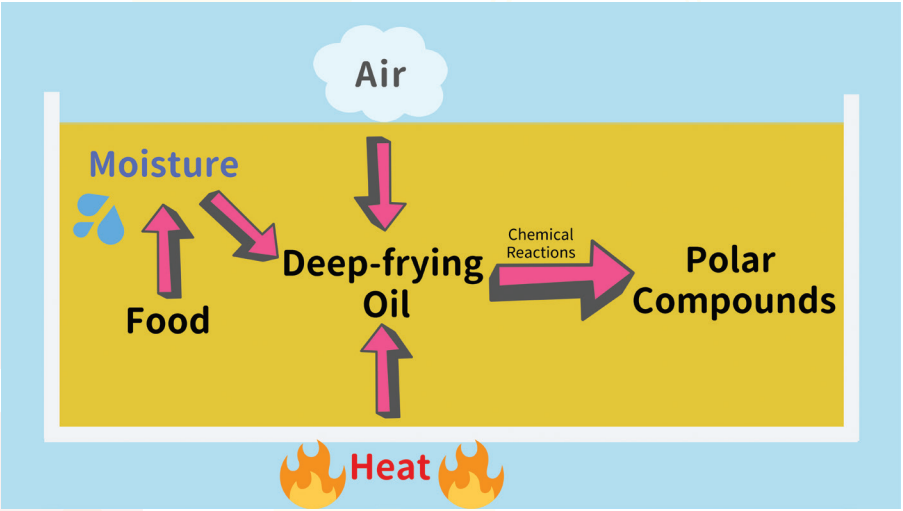

Figure 1: Major chemical reactions which occur during deep-frying

When the deep-frying oil is used repeatedly, the quality of deep-fried food would be affected. Both the deep-frying oil and deep-fried food would gradually become darker in colour and give off a rancid odour. In addition, the amount of oil absorbed in deep-fried food would increase with the number of times the deep-frying oil is reused, resulting in oilier and less crispy food.

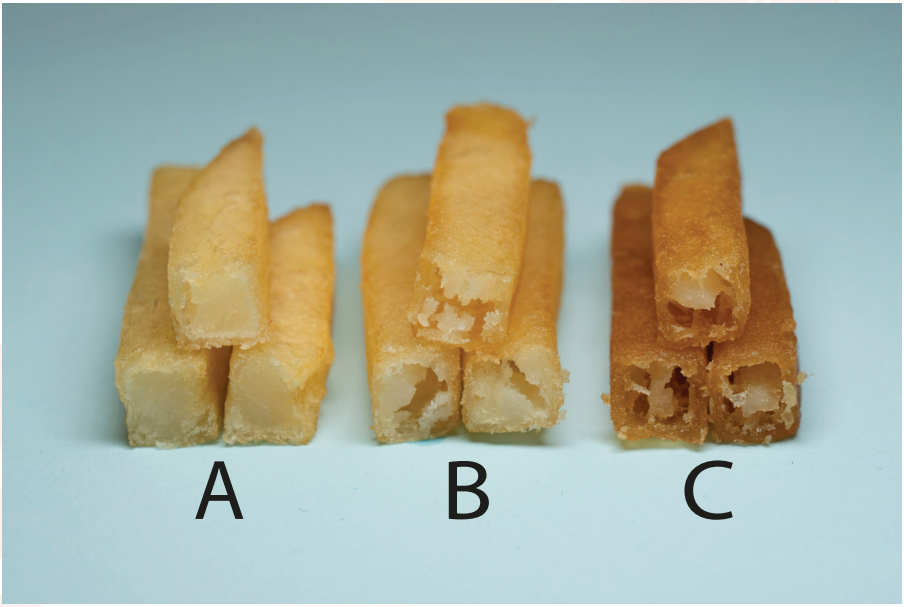

Figure 2: The effect of using repeatedly used deep-frying oil on deep-fried food quality

The potato chips, as shown in this figure, were deep-fried at the same temperature for the same duration in fresh oil (A), oil that had been used for a few times (B), and repeatedly used oil which should have been changed (C). Potato chips A had less well defined crusts and lighter colour; potato chips B had well defined golden crusts; as compared with potato chips A and potato chips B, potato chips C had darker crusts and a centre which was too dried and did not look appealing.

Possible health risks associated with deteriorated deep-frying oil

Polar compounds formed in chemical reactions can accelerate the deterioration of deep-frying oil. Many studies have shown that deteriorated oil may contain various compounds, including polymeric compounds, free fatty acids, free radicals, peroxides and acrolein etc.

Currently, results of some animal studies have shown that consumption of large amount of deteriorated oil may result in adverse health effects. Polymeric compounds produced by chemical reactions can cause vomiting and gastrointestinal distress while free fatty acids can increase the risk of cardiovascular diseases.

Brief on quality indicators of deep-frying oil

Colour and odour

Deep-frying oil quality can be assessed based on the colour and odour of the oil and the food it has fried. Even though this method is simple, quick and does not require any tools, it is relatively subjective and relies on personal experience.

Smoke point

Smoke point refers to the temperature at which oil starts to smoke. Typically, smoke point of fresh vegetable oil is above 200°C, but it would decrease gradually as the deep-frying oil deteriorates.

Foaming

Transparent steam bubbles are formed in fresh oil during deep-frying. When the oil deteriorates, the amounts of polymeric compounds and surfactants increase, causing the formation of milky foam that cannot dissipate easily on the oil surface.

Figure 3: Bubbles and foam in deep-frying oil

Figure on the left shows transparent steam bubbles that are formed in fresh deep-frying oil. These bubbles can dissipate easily. Figure on the right shows milky foam that is formed in deteriorated deep-frying oil. This foam cannot dissipate easily.

Total polar compounds

Triglycerides, which are relatively nonpolar, are the major components in fresh cooking oil while the chemical compounds formed during deep-frying are mostly polar. Therefore, the amount of polar compounds (Total Polar Compounds, often abbreviated as TPC) in deep-frying oil can be used as an indicator for assessing the quality of deep-frying oil objectively.

Recommendations on the use of deep-frying oil

Proper use of deep-frying oil and utensils can help ensure food safety as well as slow down oil deterioration. Recommendations in blue are "advanced level" suggestions for additional reference. Food traders can take into account various factors such as resources, cost and operational convenience before implementing the "advanced level" suggestions.

Before deep-frying

Select suitable oil for deep-frying

Fatty acids in cooking oil can be classified into saturated fatty acids and unsaturated fatty acids, while unsaturated fatty acids can further be classified into polyunsaturated fatty acids and monounsaturated fatty acids.

Cooking oil with higher level of saturated fatty acids	👍 Stable at high temperatures 👎 Increases the risk of cardiovascular diseases	E.g. Lard, coconut oil, palm oil
Cooking oil with higher level of polyunsaturated fatty acids	👍 Beneficial to cardiovascular health 👎 Deteriorates rapidly at high temperatures	E.g. Soybean oil, grapeseed oil, corn oil
Cooking oil with higher level of monounsaturated fatty acids	👍👍 Relatively stable at high temperatures and beneficial to cardiovascular health; suitable for deep-frying	E.g. Rapeseed oil (including canola oil), high oleic sunflower oil

Minimise moisture on the food surface

Moisture in food can cause oil deterioration easily. Moisture on the food surface should be minimised before deep-frying.

Proper use of breadcrumbs or batter

In order to minimise the accumulation of breadcrumbs and batter residues in the oil, excessive breadcrumbs or batter on the food surface should be removed before deep-frying. Residues in the deep-frying oil should also be removed frequently.

During deep-frying

Control the oil temperature between 150 and 180 °C

Using an excessively high temperature accelerates the deterioration of deep-frying oil, however, using too low a temperature increases oil absorption into deep-fried food.

After deep-frying

Remove residues

Use sieves to remove residues in deep-frying oil frequently to slow down oil deterioration.

Lower the oil temperature setting to 120-130°C when the fryer is idle

Prolonged heating or frequent heating up and cooling down accelerates oil deterioration.

Season after deep-frying as far as possible

Seasonings (e.g. salt and herbs) can accelerate oil deterioration. Food should be seasoned after deep-frying as far as possible.

Cover the fryer after it is turned off

Cover the fryer after it is turned off to minimise exposure of oil to light and air.

Clean the fryer regularly

Clean the fryer (especially the heating element) regularly to avoid accumulation of food residues. Please refer to the manufacturer's suggestion when cleaning the fryer.

Advanced level

Filter deep-frying oil thoroughly

The use of dedicated filtration powder or filtration system (see Appendix) can further improve the quality of deep-frying oil. It should be noted that filtration is not a means of replacing oil change.

Top up fresh oil as appropriate

If the level of deep-frying oil is too low, top up with fresh oil. However, with repeated deep-frying, chemical compounds continue to accumulate in the oil; topping up of oil should not be used as a means of diluting or prolonging oil use.

Changing oil

Complicated chemical reactions are involved in the deep-frying process. Oil deterioration rate can be affected by various factors, and therefore it may be difficult to recommend changing the deep-frying oil solely based on a fixed time period or the number of times it has been used. When any of the following conditions occur, deep-frying oil should be changed in a timely manner.

Deep-frying oil has an unusual colour or odour

- The colour of deep-frying oil is obviously darkened or the odour of deep-frying oil has changed significantly (such as the emergence of a rancid odour)

Deep-frying oil starts to smoke

- Smoking of deep-frying oil observed at deep-frying temperatures

Deep-frying oil starts to foam

- Formation of milky foam that cannot dissipate easily

High level of TPC

- TPC value lies between 24 and 27%: consider changing the oil
- TPC value is greater than 27%: oil should be changed

Various TPC handheld devices are available in the market for food premises' reference. After placing the sensor of the TPC handheld device into the oil, the TPC value can be analysed in approximately one minute. Please refer to the user manual provided by the manufacturer before use.

Appendix

Examples of dedicated oil filtration products are listed below. Please refer to the user manual provided by the manufacturer before use.

Filtration Types	Function	Time required	Operation
Active filtration (silicates, silica)	To remove chemical compounds dissolved in deep-frying oil	Approximately 10 to 15 minutes	Install the sieve, filter paper, and dedicated oil filtration powder into the filtration device. Transfer deep-frying oil into the filtration device. Filtered oil will be pumped back into the fryer automatically after the filtration process is completed.
Passive filtration (filtration system)	To remove small solid particles (food, breadcrumbs and batter residues, charred particles etc.)	Approximately 5 minutes	After installing the filter paper into the filtration system, deep-frying oil will be filtered automatically and returned to the fryer.

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Annex II

Recommendations on the use of deep-frying oil

BEFORE DEEP-FRYING

- Minimise moisture on the food surface
- Proper use of breadcrumbs or batter

DURING DEEP-FRYING

- Control the oil temperature between 150 and 180°C

AFTER DEEP-FRYING

- Remove residues
- Lower the oil temperature setting to 120-130°C when the fryer is idle
- Season after deep-frying as far as possible
- Cover the fryer after it is turned off
- Clean the fryer regularly
- Top up fresh oil as appropriate, but not as a means of diluting or prolonging oil use

CHANGING OIL

When any of the following conditions occur in deep-frying oil:

- Having an unusual colour or odour
- Starting to smoke
- Starting to foam

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