TRADE GUIDELINES

ON THE USE OF DEEP-FRYING OIL

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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.

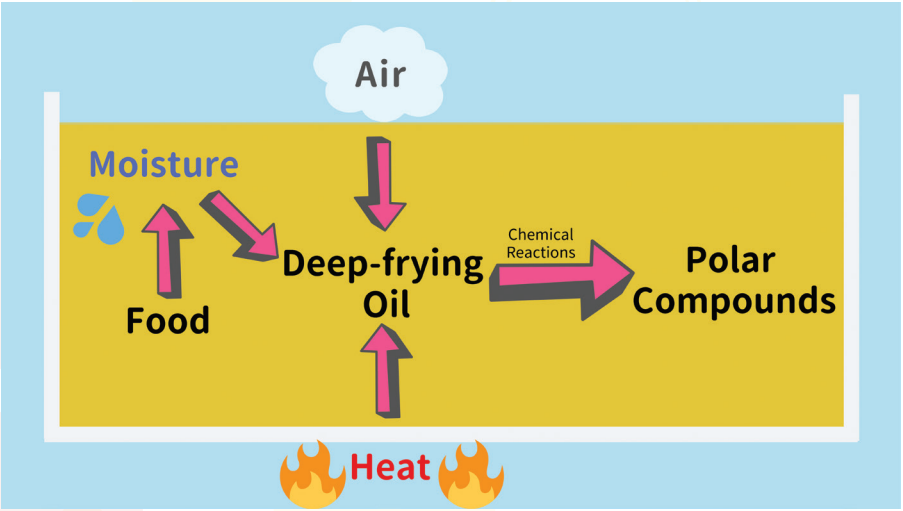

Figure 1: Major chemical reactions which occur during deep-frying

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.

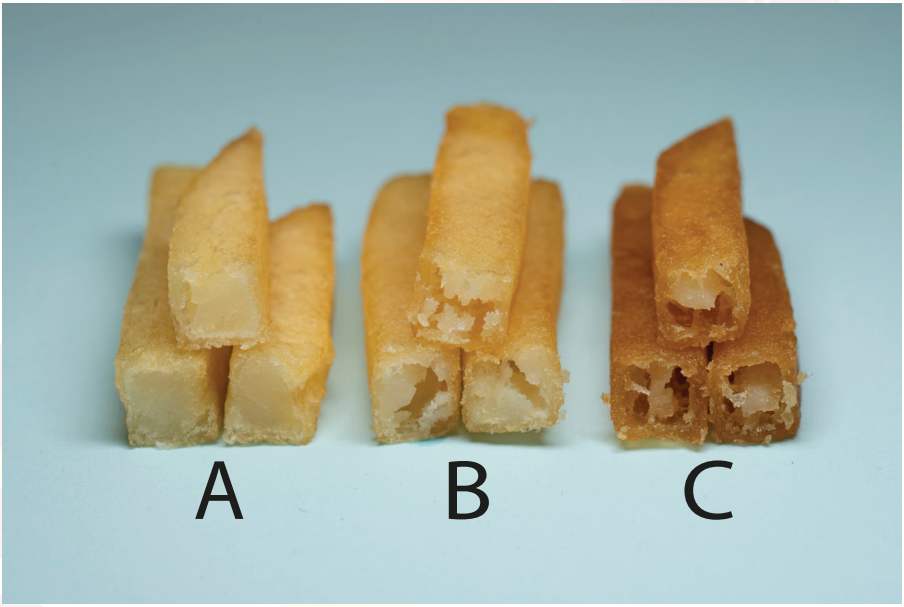

Figure 2: The effect of using repeatedly used deep-frying oil on deep-fried food quality

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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