Optimum deep-frying

Recommendations by the German Society for Fat Science (DGF, Deutsche Gesellschaft für Fettwissenschaft e.V.)

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1. Introduction

Deep-Frying is a fast and easy method to prepare tasty food – therefore despite the trend to low-fat foods, French Fries and other deep-fried products enjoy increasing popularity.

On the other hand consumers judge high-fat foods increasingly more critically. With the rising consumption of deep-fried foods, the interest to use nutrition-physiologically less problematic fats and oils and to minimize or exclude the formation of harmful substances has increased.

1.1 Regulations

Deep-frying is by definition a production process for food, with which the legal regulations of the VO (EG) 178 and the requirements of the VO (EG) 852 and 853 need to be considered. Beyond that, guidelines for large-scale catering establishments and small commercial kitchen enterprises as well as safety regulations exist in many countries.

1.2 Target group

The following recommendations are predominantly for commercial kitchen enterprises, like industrial and commercial catering and/or aligned to community food supply in enterprises and institutes.

With other areas of deep-frying, e.g. in the food industry or in the household, the recommendations for these areas are not dealt with in greater detail.

These recommendations serve as a guideline for the practice of deep-frying and are based on current scientific perception, the optimization of the deep-frying process with respect to product safety and nutritional-physiological quality of the products in culinary aspects, fat stability and handling.

2. Theory of Deep-frying

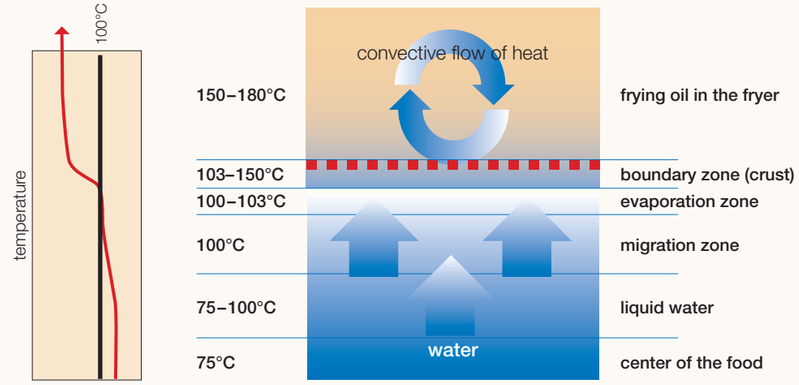
2.1 Definition

Deep-frying is a cooking process, with which water containing foodstuff is immersed into edible oils or fats at temperatures between 140 – 180 °C. In the first phase, within a few seconds, a thin crust forms, whose structure crucially affects the deep-frying process and the quality of the food with regards to fat absorption and crispness.

Fats and oils have a high heat capacity, thereby enabling heat transfer at temperatures far above that of the boiling point of water. Due to the evaporation in the boundary zone between food and oil, the water bound in the food is gradually transported from the inside to the boundary layer into the surrounding oil (mass transfer). The speed of transfer depends more or less on the structure of the outer crust. As soon as the transfer of water ends, the temperature inside the food starts to rise above 100 °C. At this point the typical deep-frying aromas and flavors as well as the gold-yellow colour begin to develop. With the rise of temperature in the boundary zone to more than 120°C, the formation of acrylamide begins, in particular in the presence of reducing sugars and asparagine like in grain- or potato products.

The moisture released from the food acts as a protective shield, preventing direct contact of oxygen to the fat surface. Consequently, frying fats that are constantly used for the preparation of meals deteriorate more slowly as if being heated up frequently without food.

Heat- and Mass transfer during deep-frying



2.2. Deep-frying process – Product safety and quality

During deep-frying not only desired changes occur, like crusting of the outer area, cooking processes within the food and the formation of typical flavour components, deep-frying also leads to unwanted changes, which finally results in the deterioration of the frying oil/fat. These changes affect both the quality of the deep-frying medium and the quality of the fried food.

Physical Parameter	Changes during deep- frying	Caused by	Correlation with the deterioration of fat (independent of the type of fat)
Refractive index/UV	Increases	Accumulation of conjugated fatty acids	Yes*
Density	Increases	Polymerized triacylglycerols	Yes*
Dielectric coefficient	Decreases	Polar-oxidized components – disturbed by free fatty acids and water	Yes*
Colour	Becomes more intensive and darker	(Maillard) reaction products of amino acids (protein) and unsaturated Carbonyl compounds	No
Conductivity	Increases	Polar compounds	Yes*
Surface tension	Decreases	Polar compounds	Yes*
Smoke point	Decreases	volatile oxidized decomposition products	Yes*
Specific Heat	Increases	Polar compounds	Yes*
Viscosity	Increases	Polymerized triacylglycerols (MG>1000)	Yes*
Chemical Parameter			
Anisidine value	Increases	Secondary oxidation products	Yes*
Iodine value	Decreases	Formation of oxidized fat and dimerised products	Yes*
Peroxide value	Increases but can also decrease	Primary oxidation products	No
Petrolether – insoluble oxidized fatty acids	Increases	Oxidized polymerization products	Yes
Polar compounds	Increases	Oxidized and polymerized degradation products including unchanged polar fat components	Yes
Polymerized Triacylglycerols	Increases	Oxidized and not oxidized polymerized Triacylglycerols	Yes
Acid value	Increases	Formation of oxidation products with free carboxyl groups	No

2.2.1 Changes in the deep-frying medium

Depending upon temperature and the duration of the deep-frying process, the heating of fats and oils will change the composition of the medium and eventually lead to the degradation of the fat. In order to produce optimal sensory results the oil must have experienced some initial thermal decomposition. On the other hand fat degradation is not reversible, the processing must aim at obtaining and maintaining optimal conditions for the production of tasty food for as long a time as possible. This is not a simple task, as complex physical procedures and chemical reactions take place during deep frying, which are influenced by temperature and also by the interaction between the oil/fat, the food item and atmospheric oxygen.

Decomposition:

Food fats and oils are (from a chemical point of view) mixtures of triacylglycerols (non-polar components), which are composed of fatty acids and glycerol. Such triacylglycerols are affected by oxygen and heat, whereby, due to oxidation and polymerization more polar compounds like free short-chain fatty acids, mono- and diglycerides, aldehydes, ketones, polymers, cyclic and aromatic compounds are formed. Some of these compounds are responsible for the pleasant flavour of the deep-fried products. At the same time however, oxidation products such as short-chain fatty acids lead to a decrease of the smoke point, so that the fat starts smoking at clearly lower temperatures than the fresh fat. In addition it develops a gritty taste. Polymeric components lead to the formation of foam and increase the viscosity (i.e. the deep-frying medium becomes more viscous). Especially when palm kernel oil and coconut fat are used, water from the fried food splits off fatty acids (hydrolysis), forming an eye-irritating smoke due to the formation of toxic acrolein and free short and middle chained fatty acids. With other fats and oils the hydrolytic splitting rises only to a very small extent.

2.2.2 Changes in the fried foods

Desired Changes

At the beginning of the process the agglutination of starch and the denaturing of proteins occur. These changes in the fried food improve the digestibility and taste of the food. The colourization (browning) of the food and the accumulation of flavour components are to be attributed to the *Maillard* reaction. The loss of the moisture at the surface leads to the development of the crust.

Undesired Changes

Depending upon the surface/mass ratio of the fried food, the amount of fat uptake in the deep-fryer will be affected, with potato chips or crisps ranging from 30-40%, with donuts 15-20% and with fried potatoes (french fries, chips) 6-12%.

Since food products absorb the fat, the selection of the frying oil/fat is of nutritional-physiologically relevance. In addition, the correct processing methods need to be taken into consideration in order to steer the oil uptake of the fried foods.

The greater part of oil uptake (80%) takes place after removing the fried foods from the fryer. Studies show that on the surface fat is absorbed through the cooling effect. During deep-frying the water vapours are released from the inside of the fried foods by small channels. When the fried food is taken out of the frying medium, air cools down into the channels and develops a vacuum, which absorbs the fat on the surface and sucks it into the channels. Therefore in order to reduce the fat absorption of the fried foods, it is important that the fried foods are allowed to drip off under warm conditions. (See 4.3 Filling)

Acrylamide

The heating of foods (rich in starch and poor in water content) by baking, roasting, grilling, frying and deep-frying may cause the formation of acrylamide in the presence of protein components like asparagine and reducing sugars like glucose.

The formation of acrylamide can clearly be minimised through a short deep-frying process with temperatures not exceeding 165 – 175°C and by the selection of food with a suitable volume/surface ratio. A large volume and a small surface reduce the acrylamide content of the product further.The rule of thumb is that food should not be heated longer than necessary, especially not potato products.

3. Selection of deep-frying oils and fats

The selection of deep-frying oils should be based on the optimization of the process with regards to nutritional-physiological and culinary aspects. Cost should not be the only decisive factor at the centre of attention. During deep-frying a substantial portion of the deep-frying medium may be absorbed by the food. In addition there is an exchange between the fat present in the food and the deep-frying medium i.e. the fatty acid composition of the deep-fried food is determined considerably by the fatty acid composition of the deep frying medium. Thus deep-frying with animal fats result in a high portion of saturated fatty acids in the food while, deep-frying in olive oil rises the content of monounsaturated oleic acid.

In addition and of great importance, the changing degree of thermal-oxidative degradation in the deep-frying medium can strongly affect the quality and the stability of the deep-fried product. The flavor of deep-fried foods is likewise contributed by the fats used, as a certain portion of polyunsaturated fatty acids contribute to the flavours associated with deep-frying, it is therefore recommended that vegetable oils be preferred instead of the more heat-stable firm fats. Only for a very few uses is the consistency of the deep-frying medium of importance; here fat which is solid or semisolid at ambient temperatures is clearly preferred. The choice of the deep-frying medium is always a compromise between the technological and nutritional-physiological requirements.

3.1 Nutrition-physiological Aspects

Three parameters have substantial influence for consideration: the quantity of fat absorbed by the food, the quality of the frying oil (chemical composition) and the degradation status of the frying oil.

In the average population the supply of energy by fat in nutrition is too high and should be reduced, particularly in order to prevent cardiovascular diseases and diabetes. In order to reduce the fat absorption by the consumption of fried food, the correct processing (among other things the correct deep-frying temperature) and the dripping off of the oils/fats of the deep fried foods is of substantial importance, as poorly fried foods can contain unnecessarily high amounts of fat.

Fatty acids, the building blocks for all fats and oils, are almost identical in respect to energy content, but they differ chemically by saturation degree and chain length. Vegetable oils are rich in unsaturated fatty acids, solid fats on the other hand consist mainly of saturated fatty acids.

3. SELECTION OF DEEP-FRYING OILS AND FATS

From the nutritionist point of view, the mono-unsaturated oleic acid, which can be found in olive oil and rapeseed oil, is to be preferred. The polyunsaturated fatty acids, linoleic – and *alpha-linoleneic* acids are essential, but should be consumed in a ratio not higher than 5:1, the linoleic acid uptake within the diet being in general too high. Both fatty acids, are basic material for different hormone-similar substances in the metabolism which are effective against cardiovascular diseases. In addition *alpha-linolenic* acids help against certain inflammatory processes.

In terms of temperature stability and oxidation stability against atmospheric oxygen, saturated long chain fatty acids are more stable than the corresponding unsaturated fatty acids. The important essential fatty acids, linoleic – and linolenic acids are less stable with longer hours and/or days of continuously heating over 175/180°C. For sensory reasons the linolenic acid concentration of the frying oil should be less than 3 %, otherwise it could contribute to a fishy flavor within the product and the deep-frying medium. Frying of foods at higher temperature using soybean, corn or rapeseed oil can be a cause of indoor pollution due to the formation of toxic acrolein.

Nevertheless, the nutrition-physiologically favorable oils can be used for deep-frying if certain rules are obeyed. The deep-frying temperature should not exceed 180 °C. The fresh oil should be protected from light and stored in a cool place, it may even be necessary to use stabilizing additives. The contents of polyunsaturated fatty acids should not be too high, therefore linseed oil or saflor oil is frequently considered inappropriate for deep-frying.

Trans-Fatty acids:

Trans-fatty acids are special unsaturated fatty acids, which are classified as potential health risks. They are formed in relevant quantities during the heating process of oil and fat only at temperatures above 200°C and during the hardening of fats (hydrogenation). Normal deep-frying conditions result only in a small amount (<1 %) of *trans*-fatty acid formation. Deep fried foods only contain increased quantities of *trans* fatty acids, when these are baked in partly hardened fats and oils. Even the fat of pre-fried foods don't have a large influence on the content of *trans*-fatty acids in the deep-fried food, as this fat is exchanged almost completely against the deep-frying medium. One possible alternative to thermally stable partly-hardened fats and oils are high-oleic acid vegetable oils like high oleic sunflower oil or high oleic low linolenic rapeseed oil, which exhibit a comparable or better stability, but contain no *trans*-fatty acids.

Allergens:

There are no existing obligations for the labelling of allergens in terms of food identification in the community food supply and catering trade, yet some references to a meaningful allergen management are mentioned here.

In accordance with the actual guidelines of the European Union, peanut oil and fat and soybean oil are classified allergens. However, a limited special arrangement applies according to which fully refined soybean oils are considered non-allergenic. In addition, in accordance with the allergen guidelines, foods such as fish and crustaceans must be prepared in separate deep fryers, if parallel e.g. in a large-scale catering establishment where all-allergen-free meals are prepared. The entire deep-frying process must be documented in a current HACCP concept (Hazard Critical Control Points) (see EC (No 852/2004).

3.2 Culinary Aspects

Deep-frying is a simple and fast method of food preparation. Deep-fried meals are enjoyed, due to their high consumption value, its crusty golden colouring with simultaneous juiciness of the food.

The deep-frying oil and fat should taste and smell neutral and should underline the taste of the meal itself. The selection of the deep-frying oil and fat and the deep-frying conditions also affect the estimated crispiness and browning of the deep-fried foods.

When using virgin oils for deep-frying, the typical, and species-characteristic taste of the used oil is absorbed into the fried foods, which may be or may not be desired.

3.3 Technological Aspects

In principle all oils and fats are suitable for deep-frying. Virgin oils can be heated up exactly the same as refined oils although they have a lower smoke point due to the higher amount of free fatty acids. Solid fats which are rich in saturated fatty acids (e.g. stearic acid), offer a higher temperature- and oxidation stability than oils with a high content of unsaturated fatty acids. However, high contents of short and middle chain saturated fatty acids (e.g. in coconut and palm kernel oil) increases the formation of smoke and foam due to hydrolytic reactions.

Liquid oils with high contents of mono- and polyunsaturated fatty acids are more favourable from a nutritional-physiological view.

While mono-unsaturated fatty acids (e.g. oleic acid) have sufficient temperature stability, higher amounts of polyunsaturated fatty acids (e.g. linoleic acid, above all however linolenic acid) leads to quick oxidation.

The degradation of the linolenic acid however contributes crucially to the typical deep-frying flavour.

In practice vegetable oils are well applicable, however they require increased attention in the processing and in the maintaining of the oil and may also require the addition of stabilizing agents.

A semi-liquid deep-frying medium usually combines the stability advantages of a solid fat with the positive nutritional-physiological characteristics of liquid oil. The semi liquid consistency also allows favourable handling by the user.

4. Processing

4.1 Equipment

Deep-fryers must be made of stainless steel, enabling easy cleaning and maintenance. They should be equipped with a discharge opening for the deep-frying medium, secured against unintentional operation. The fryer should be placed under a fume hood to avoid inhaling toxic fumes (acrolein).

The heating mechanism must be easy to regulate and provided with a well controllable temperature limiter to exclude any overheating of the deep-frying medium.

The temperature control should be examined regularly using an external thermometer for accuracy and the temperatures should be documented in the context of a HACCP concept.

4.2. Start-up

Solid deep-frying fats need to be pre-heated and melted a few minutes at a maximum of 60°C, before heating them to the actual operating temperature.

4.3 Filling

Deep-frying quantities:
The ratio of the deep-fried food to the deep-frying oil and fat should not exceed 1:10, in order to avoid a strong temperature decrease during filling. Modern deep-fryers have an appropriate temperature control system. Older deep-fryers with mechanical temperature controls may cause substantial temperature differences which can lead to a faster fat degradation.

Separate deep-fryers:
The separation of the different food products prevents mutual flavour influence. Ideally, separate deep-fryers should be used for each of the following foods:

- for fish – because of the intensive species-characteristic smell and taste
- for potato products (french fries) – due to their specific characteristics
- for meat, poultry and vegetable products – due to their intensive colouring caused by the Maillard Reaction
- when required: separation between vegetable and meat containing products

Wet food: should be dried before deep-frying to avoid spitting and to achieve an even crust of the fried foods and minimal fat absorption.

Frozen foods: should be defrosted and dried briefly to remove the surface dampness of the fried products.

Avoidance of salts and spices before deep-frying: Salt promotes the migration of water from the inside to the surface of the food and the formation of toxic substances.

Salts and spices over the deep-fryer: must be avoided, since both salt remains and the contents of some spices have an unfavourable effect on the heat stability of the deep-frying medium.

Shake off crumbs: Before inserting crumbed foods, e.g. schnitzel, loose crumbs should be shaken from the foods. Small parts char easily in the deep-fryer and accelerate fat degradation.

4.4 Temperature

- The temperature as well as the proper function of the thermostat should be examined regularly.
- The adjusted temperature of the deep-fryer should not exceed 180°C and preferably lie within a range of 160-175°C. Higher temperatures do not mean shorter cooking times, but lead however to a faster fat deterioration and accelerate the acrylamide formation within starch containing foods.
- With longer interruptions the deep-frying temperature should not be lowered under 120°C - 130°C, as the temperature range between 70°C and 120°C has an unfavourable effect on the heat stability of the deep-frying medium. Preliminary stages of fat oxidation (hydroperoxides) are formed particularly during the cooling phase in the temperature range of 70°C - 120°C, which quickly form aromatic compounds when the oil is heated up again.

  With start-up, the deep-fryer should not be heated up to over 60°C to melt the fat. If the used deep-frying medium is not used over a longer period, even then at ambient temperatures the fat starts to deteriorate.

4.5 Interruptions / Process end

Temperature reduction: see above

Covering of the deep-fryer not in use: to protect the fat against oxygen, light, dust and water, the oil and fat surface in the dwell phases must be covered. This prevents additional deterioration of the deep-frying medium by oxidation and photooxidation.

Additions to the deep-frying medium: The oil uptake of fried food leads to a constant discharge of deep-frying oil from the fryer. The missing quantity of frying oil and fat must be supplemented regularly.

The fat degradation is not accelerated by the continuous addition of fresh oil, but helps to produce food with constant quality and to extend the usefulness of the oil. The degree of degradation should be held at a constant level between 10-18 % total polar compounds. With a daily exchange of approximately 20% - 25% of the used oil against fresh oil, the measurable degradation can be kept constant and therefore the oil be used longer producing good tasting fried products.

Filtration: After completion of the deep-frying process, the still warm deep-frying medium should be passed through a temperature-resistant filter in order to remove small parts e.g. food residues and bread-crumbs completely, as their presence can accelerate the fat deterioration. It is a myth that degradation products can be eliminated by filtering.

Increasingly, continuous filtration systems are used which clean the deep-frying medium during the deep-frying process. Active and passive filter aids cannot regenerate the deep-frying medium, but help to slow down the fat deterioration by 10% - 20%, independently of the filtering medium.

Cleaning: Deep-fryers are to be emptied after use and cleaned. Fat rests must be removed in order to avoid oxidation. Gummed deposites on the heating tubes reduces the heat transfer. The fat rests will promote faster fat deterioration and quality losses when the deep-frying is operating again.

Alkaline cleaning agents are to be used extremely sparingly, in order to not disturb the function of the fat separator by formation of soaps. New fat containing cleaning agents and mechanical aids are recommended.

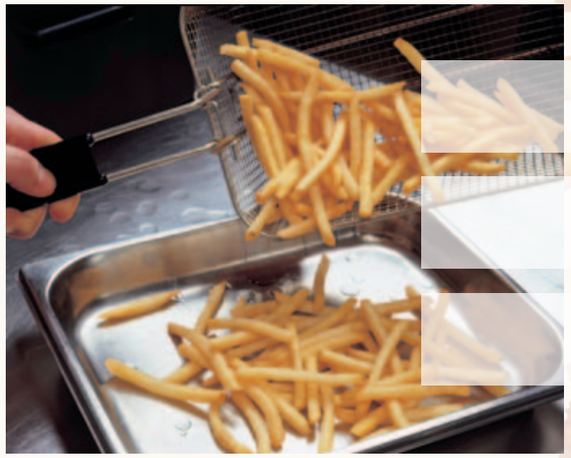
Change of the deep-frying medium: The deep-frying medium must be changed in time, in order to be able to provide a fat change plan in accordance with a HACCP concept. Regular examinations must be undertaken to evaluate the end point with a sensory examination. Additionally, testing equipment and results of chemical analyses are to be used. (see 5. Evaluation of the deep-frying oil/-fat).

4.6 Staff

The staff should be instructed over the intended use of the deep-fryer, appropriate hygiene regulations and substantial precepts regarding possible dangers (see 7th occupational safety).

4.7 Documentation

In the course of a HACCP concept and applied quality management system, all documentation for control measures of the deep-frying process as well as the respective changes of the deep-frying medium should be duly and correctly completed.



5. Evaluation of the deep-frying oils/-fats

During the deep-frying process the quality of the deep-frying medium should be constantly monitored. In practice, sensory examinations and quick-tests (due to their simplicity and handling) are recommended for onsite testing. However, these measures cannot replace the chemical analysis by a laboratory, as colour tests and physical measuring procedures can be influenced by different factors.

Laboratory examinations involve the use of more time-consuming physical and chemical methods.

5.1 Sensory evaluation

Used deep-frying oild and fats are considered to be mistreated when they exhibit definate smell and taste defects and if they show an intensified formation of smoke and foam during the deep-frying process. Intensified darkening, however, is not a measure of deterioration. The colour is almost always caused by the reaction of proteins with fat components or sugars.

5.2 Quick tests

These are based on chemical or physical principles.

Colorimetric procedures determine the amount of degradation products of fatty acids (carbonylic compounds) by a colour reaction.

Other quick tests based on colour reactions aim at determining the portion of polar compounds or the acid value.

Further high-speed methods are based on a redox reaction and determine the amount of oxidized fatty acids.

Physical high-speed methods try to determine fat deterioration by measuring the foam height, the viscosity or the dielectric constant. Nearly all quick tests are affected by the type of fat or oil and therefore only its continuous use permit the correct estimation of fat deterioration.

5.3 Analytical methods

Physical methods include the determination of the smoking point, the viscosity, the conductivity, dielectricity constant and increasing colour. All these procedures are not suitable to describe the quality of a deep-frying medium quantitatively, but provide rather rough reference points for its evaluation.

Chemical methods include the determination of free fatty acids (acid value) by acid-base titration, of polar compounds by means of chromatographic procedures, of polymer triacylglycerols and oxidized fatty acids. The acid value is dependent on the kind of fat and therefore not suitable for the objective determination of the degradation condition.

Only the determination of the polar compounds and the polymer triacylglycerols permit an objective evaluation of the thermal load condition of deep-frying fats.

5.4 Codex Alimentarius

Used deep-frying mediums are generally considered as deteriorated, if they clearly exhibit objectionable smells or taste (e.g. strong mildew, strongly gritty, rancid, varnish, bitter) and if these sensory impressions are objectified through further analytic criteria like the polar compounds and polymer triacylglycerols.

6. Deep-frying additives

A variety of deep-frying additives and filter auxiliary materials are available on the market. They may consist of individual components like synthetic antioxidants or of mixtures, which contain both synthetic and natural components. For this purpose, all components must be certified as food additives within the European Union.

It should be emphasised that deep-frying additives do not influence the deep-frying fats, but help to support and maintain the good characteristics of the deep-frying medium longer by delaying the fat degradation. Due to their chemical composition, only complex additives retard the thermally oxidative fat degradation process effectively. They reduce oxidation at temperatures of up to 130°C and polymerization at higher temperatures. Dimethylpolysiloxan (E 900) prevents excessive foaming, whereby the surface is protected by a mono-layer film. With intermittent frying it can decrease – to some extent – the oxidation, while with continuous frying E 900 has no effect on the stability of the deep-frying medium.

7. Occupational Safety

In order to prevent irritation of mucous membranes by fat vapours, fume hood systems or air-cleaning installations are necessary during deep-frying.

For fire safety reasons water handling should be avoided in the proximity of deep-fryers and cover protection is needed to prevent spitting.

There should be no fire sprinklers present over the deep-frying area.

While operating the deep-fryer the wearing of aprons, gloves and socks made from artificial fibres should be avoided.

Under no circumstances should water be used to extinguish a fire resulting from the deep-fryer, as this causes an explosive evaporation of the water from the hot deep-frying medium, leading to a violent explosion (fat explosion).

In areas where the total deep-frying fill amounts exceed 50 litres (e.g. 4 deep-fryers each containing 15 litres), then a stationary fire-extinguishing equipment must be installed.

New research has shown that commercial fire dousing blankets, fire extinguisher based on carbon dioxide, as well as different dry powder systems have little effect on extinguishing a fire resulting from a deep-fryer. Here fire extinguishers operating with foam are more suitable, as they block the access of oxygen and lower the temperature at the same time, resulting in backfire prevention.

The personnel should be instructed over the correct use of a deep-fryer and over the possible dangers and their prevention.

Food Safety Authority of Ireland, Factsheet Guidance on the use and handling of frying fats and oils, www. fsai.ie/publications/factsheet/guidance_frying-_oil.asp

Österreichisches Lebensmittelbuch III. Auflage, Kapitel B 30, Verlag Brüder Hollinek, September 1996

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CHECK LIST FOR DEEP-FRYING

BEFORE DEEP-FRYING

- Preheat the deep-frying fat with a max of 60°C for some minutes before start up.
- Control the oil temperature using an external thermometer
- The deep-frying quantities: the ratio of food to deep-frying oil or fat should not exceed 1:10.
- Separate deep-fryers should be used for fish, potato products and finally meat, chicken and vegetables
- Wet food products should be dried
- Frozen food products should be defrosted and dried
- Avoid salt and other spices before deep-frying
- Shake off any crumbs from food products that have been coated in breadcrumbs
- All fire extinguishers must be check every 2 years for suitability of use

DURING DEEP-FRYING

- Ideally the temperature should lie between 150°C –175°C, and preferably not exceed 180°C
- The deep-frying temperature should be continually controlled using an external thermometer
- Avoid adding salts and other spices to the deep fryer
- All control checks and changing of the deep-frying oils/fats must be strictly documented

AFTER DEEP-FRYING

- The fat should be allowed to drip off while still warm
- During long breaks in deep-frying the temperature should be reduced, during short breaks the deep-frying temperature should be maintained.
- During breaks the deep-fryer should be covered
- The deep-frying oil or fat quantities should be supplemented
- The deep-frying oil or fat should be filtered to remove any remaining food rests
- The deep-fryer should be thoroughly cleaned
- Replace the deep-frying oil or fat before total degradation occurs
- Unused deep-fryers should be emptied and cleaned carefully

FAT EVALUATION

- Sensory evaluation (smell and taste): gritty, rancid taste, smoke development, increased foam formation.

  Note! – darkening is not a measure for fat degradation
- Quick tests for rough orientation
- Laboratory tests – determination of polar components and polymer triacylglycerols

CHECK LIST – DEEP-FRYING

Deep-frying No.:   **Month/Year:**

Specifications: Sensory examination, filtration and cleaning must be carried out at the end of each day of use, temperature controls must be made once a day. Fresh fat addition as required

Day	Time	Fat Management				Deep-fryer		Operator/ Signature
		Addition	Complete change	Filtration	Sensory evaluation	Temp. Control	Cleaning	
1	8.00	2 kg	No	No	Ok	175°C	No	gg