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Revolutionizing the Frying Industry: Beyond Oil's Novel Solution May Reduce Cancer Risks Associated with Repeatedly Frying Oils

Compiled, Critically Reviewed, and Reported

By

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About Prof. Nissim Garti

Prof Nissim Garti is a full professor Emeritus of the Hebrew University of Jerusalem, Israel. He has bestowed the Ratner Chair of Chemistry of the Hebrew University, honoring outstanding scholar achievements and retaining top faculty recognition. He brings an incomparable track record of expertise in physical and chemical properties of fats and oils and on dispersed systems, emulsions and double emulsions, crystallization, and interfacial phenomena, food Science, nutraceuticals and cosmeceuticals, hydrocolloids.

Prof. Garti's background includes over 40 years of 'product-oriented research' at the Graduate School of Applied Sciences, Casali Institute of Applied Chemistry at the Hebrew University of Jerusalem.

Prof. Garti was twice the director of the Casali Institute and the Center for Applied Chemistry and is a member of the Nano-Science Center of the Hebrew University.

His work has been selected among the most "groundbreaking inventions and innovations of researchers" at the Hebrew University of Jerusalem, and he is a member of one of the 23 Scientists that were placed in the HU Innovation and Inventors 'Hall of Fame'. His innovations have brought benefits to humankind and to the general quality of life in a variety of areas: health, agriculture, technology, and environmental protection.

Prof. Garti has received and been nominated for many international awards, including the Surfactants in Solutions (SIS) Society, European Colloids Chemists Society (ECIS), International Food Technology (IFT) Society, Rockefeller Award, Colloids and Interactional Sciences (CSI), Food Structure, Crystallization Phenomena of all the three main Awards of the American Oil Chemical Society (AOCS) on fats and oils. He wrote 15 books, 410 peer-reviewed manuscripts, 80 patents, and 85 chapters in books on various aspects of molecular architectures, self-assemblies, and crystallization phenomena are considered prestigious textbooks for experts in the fields worldwide.

Garti consulted many of the global companies of food, agriculture, and cosmetics.

For more information about Prof. Nissim Garti: https://nissimgarti.huji.ac.il/prof-nissim-garti

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Summary

This report is a critical review of past extended studies published in the scientific literature, patents, American and European Health Agencies and legislations, reports, and recommendations in view of the novel Beyond Oil technology aimed to better utilize repeated use of frying oil, in order to minimize severe health risks including cancer derived from frying by-products.

The author of this report critically examined the Beyond Oil Formulation (BOF), and the results from independent international analytical labs, determining the levels of PAH, and AA in various frying oils. This report includes critically reviewed results from experiments carried out in the marketplace related to reducing levels of PAH and AA in untreated and repeatedly heated oils compared to the oils treated by the BOF.

The author is demonstrating in a set of experiments that while all nine major PAH compounds, after 4 days of frying in the oil in a restaurant in Israel (without using BOF) that were detected by chromatographic methods after continuous frying at a total level of up to 40.29+-0.57 micrograms/kg respectively will be lowered using Beyond oil Technology to almost undetectable levels or as low as 2 micrograms per liter oil.
In several experiments, the oil was filtered with BOF for 4 days of frying, and the result was amazing- all nine PAH compounds were not detectable, and the total PAH was below 0.5 micrograms per kg of oil. The results were summarized after analysis of MERIEUX NUTRASCIENCE company using MP0998 REV 4 3013 method that has the expertise to analyze the PAH compounds.

These results are very convincing and indicate clearly that Beyond Oil has a very significant solution to improve dramatically the quality of repeatable frying oil, and minimize or remove even small quantities of these hazardous compounds, and eliminate them completely (practically nondetectable).

Adopting the Beyond Oil innovative solution and using the BOF to reduce the formation of harmful compounds such as Total Polar Material (TPM), Free Fatty Acids (FFA), PAHs, and AA, will enable restaurants, food producers, and other food manufacturers to offer safer and healthier food to their customers. The BOF can help reduce the risk of severe diseases and improve the population's general health.

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Review articles and many global studies have demonstrated that most of the formation frying vegetable oils exhibit health risk factors. The toxic effects of PAH, which may be present in our foods and significantly risk our health, even if their quantities in certain foods, and mainly in oils, are very small, should be omitted from the frying oils.. It should also be stressed that most of the health concerns derived from the intake of PAH and AAs were included in the US National Institute of Health (NIH) in the National Library of Medicine of the USA report of 2022.

The "EUROPEAN COMMISSION of HEALTH and CONSUMER PROTECTION DIRECTORATE-GENERAL Directorate C - Scientific Opinions C2 published a Health Warning with regard to PAH in food products. Another report from "European Management of Scientific Committees" discusses and exposes the risks of "Polycyclic Aromatic Hydrocarbons – occurrence in foods, dietary exposure and health effects".

Beyond Oil technology “fights” all these risk factors by minimizing, or removing all the polar hazardous compounds, thus reducing the risk factors of cancer resulting from the carcinogenic compounds and by-products.

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1. Introduction

Frying oils and fried foods are consumed by billions of people globally in restaurants, industrial factories, and homes every day.

This report sheds light on a pervasive issue in the food industry - the use of reused frying oil in restaurants, hotel kitchens, and industrial factories that produce fried foods.

The problem is that large quantities of oil are used for frying, and financial considerations often take priority over health concerns, leading to oil being used for several days until it foams, burns, and smokes and practically cannot be used any longer. At that stage, it is too late. As it will be shown by this report and based on much research, prolonged use of frying oil can lead to the formation of cancer-causing compounds such as polycyclic aromatic hydrocarbons (PAHs) and acrylamide (AA) in fried food. These compounds have been linked to several types of cancer and pose a significant health risk to consumers.

Eating this fried food, or even smelling fried oil over time, according to these studies, has the potential to develop various types of cancers and other diseases.

The lack of awareness and knowledge of the food industry and food service companies' owners, cooks, and chefs regarding the health damage caused by frying oil to them and their customers results in them consistently prioritizing financial costs over health.

This report is a critical review and summary of past extended studies published in the scientific literature, patents, American and European Health Agencies and legislations, reports, and recommendations. The report brings relevant information based on the author's significant scientific expertise in these areas. The author critically examined the Beyond Oil formulation (BOF), and examined results from independent analytical labs, determining the levels of PAH, and AA in various frying oils. This report includes critically reviewed results from experiments carried out in the marketplace, related to reducing levels of PAH and AA in untreated and repeatedly heated oils compared to the oils treated by the BOF.

The author is demonstrating in a set of experiments that while all nine major PAH compounds, after 4 days of frying in the oil in a restaurant in Israel (without using BOF), are detected by chromatographic methods at a total level of 4.29+-0.57 micrograms/kg.

In the same restaurant, the oil was filtered with BOF for 4 days of frying and the result was amazing- all nine PAH compounds are not detectable, and the total PAH are below 0.5 micrograms per kg of oil. The results were summarized after analysis of MERIEUX NUTRASCIENCE company using MP0998 REV 4 3013 method that have the expertise to analyze the PAH compounds.

These results are very convincing and indicate clearly that Beyond Oil has a very significant solution to improve dramatically repeatable frying oil and minimize or remove even small quantities of these hazardous compounds and to eliminate them completely (practically nondetectable).

The AA levels, using the MP 2149 REV 1 2016 method, were also analyzed by MERIEUX NUTRASCIENCE company (under the accreditation of ISO 01/7025), and the results indicate that while traces were detected, the levels in the non-treated oil are very low. In the treated and filtered oil, the levels were reduced to non-detectable. The analytical results are attached in Appendix 2. The levels in the non-treated oil are very low, and only traces were detected. In the treated and filtered oil, the levels were reduced to non-detectable.

Several studies conducted worldwide over the past few years have shown that the BOF has the potential to significantly reduce the risk of morbidity and mortality from various types of cancer and other diseases. This is particularly relevant given the direct link between fried food consumption and the development of serious diseases, as shown by many studies.

Adopting the Beyond Oil innovative solution and using the BOF to reduce the formation of harmful compounds such as Total Polar Material (TPM), Free Fatty Acids (FFA), PAHs, and AA, will enable restaurants, food producers, and other food manufacturers to offer safer and healthier food to their customers. The BOF can help reduce the risk of severe diseases and improve the population's general health.

Recent review articles, including the one published in Int. J. Mol. Sci.,22(11), 6010, summarized most of the previous studies investigating formation and hazardous of cooking and frying vegetable oils. A review entitled: "Polycyclic Aromatic Hydrocarbons (PAH) in Foods: Biological Effects, Legislation, Occurrence, Analytical Methods, and Strategies to Reduce their Formation", is stressing the toxic effects of PAH, which may be present in our foods and significantly risking our health, even if

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their quantities in certain foods, and mainly in oils, are very small (Int J Mol Sci. 2021, 22, 6010). It should also be stressed that most of the health concerns derived from the intake of PAH and AAs that are reviewed here were included in warnings by the US National Institute of Health (NIH) in the National Library of Medicine of the USA report of 2022.

The "EUROPEAN COMMISSION of HEALTH and CONSUMER PROTECTION DIRECTORATE-GENERAL Directorate C - Scientific Opinions C2 published a Health Warning with regard to PAH in food products. Another report from "European Management of Scientific Committees" discusses and exposes the risks of "Polycyclic Aromatic Hydrocarbons – occurrence in foods, dietary exposure and health effects".

2. What are Total Polar Materials (TPM)

Total Polar Materials (TPM, also known as Total Polar Compounds (TPC), refer to all products present in frying oil due to a complex set of reactions, including hydrolysis (by water), oxidation (by air), and polymerization processes, including FFA decomposition, products of low molecular weight decomposition, and polymerized substances. Figure 1 demonstrates the three pathways to the formation of the TPM after heat-treating vegetable oils.

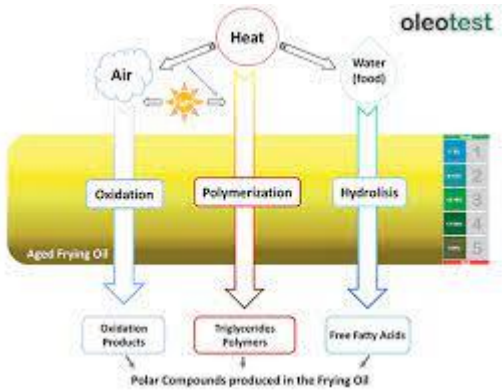

Figure 1- Hydrolysis, oxidation and polymerization leading to the formation of polar materials such as free fatty acids, polymers and oxidative products in frying oil.

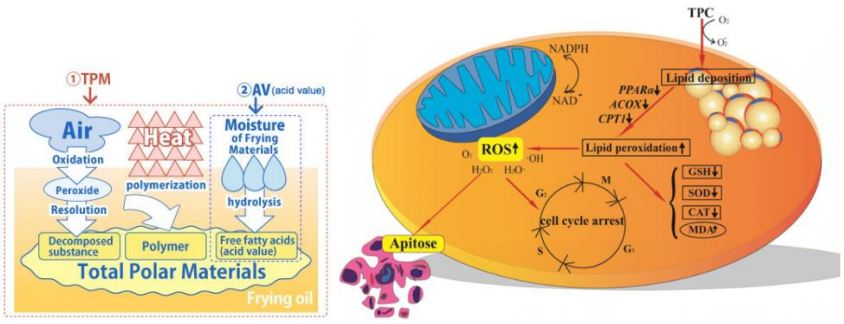

Figure 2- Parameters such as air, heat and moisture affecting the formation of the Total Polar matter(TPM) and the mechanistic pathways.

The EU has adopted a value for the so-called Total Polar Matter (TPM), or total Polar Compounds (TPC) of **25 to 27%** as their acceptable upper limit for fats and oils. Total Polar Compounds (TPC), whose polarity is higher than those of triglycerides, that are generated from peroxides, and hydroperoxides during continuous frying, including short-chain fatty acids, aldehydes, ketones, alcohols, and nonvolatile products, are an indication of unacceptable frying oil that must be replaced before continuing to fry. The mass concentration of TPM is used as an indicator of the quality of frying fats. According to official methods, the fat or oil is separated into polar and non-polar fractions by preparative column chromatography (PCC).

The oil quality during the frying process should be analyzed by combining tradition chemical indexes and electric conductivity (EC). The correlation between the quality index of frying oil and total polar compounds (TPM) was set by health authorities as a guideline for manufacturers of fried oils.

It should be noted that TPM was positively related to the electric conductivity (EC), acid value (AV), carbonyl value (CV), peroxide value (POV), and *p*-anisidine value (PAV) of frying oil. The correlation coefficient between TPM and other quality index decreased in the order of EC, AV, CV, POV, and PAV and were 0.9583, 0.9303, 0.9152, 0.7949, and 0.7082, respectively.

The EC method became an official tool to predict the TPM and discard point of frying oil.
A digital cooking oil tester enables to work more reliably and efficiently measuring TPM and helps to achieve impeccable quality assurance. Easy cooking oil monitoring using allows to observe critical TPM, so that change the oil at just the right time will be indicated by the device.

Figure 3- Simple device measuring the TPM by EC

1. What are PAHs?

Polycyclic Aromatic Hydrocarbons (PAHs) are a class of potentially mutagenic substances. They comprise over 200 organic compounds containing two or more fused aromatic rings. According to the number of aromatic rings, they can be classified as light (2–3 rings) or heavy (4–6 rings) (PAH4) compounds. The pyrolytic process that generates PAHs involves several fundamental factors, such as high temperatures, reduced oxygen levels, and organic matter, resulting in incomplete combustion of the organic matter. This process generally yields a complex mixture of PAHs, which in turn can accumulate in the food chain and can affect our health.

The pyrolytic processes that generate the PAH are present in many food products that undergo heating. PAH is also generated in many baked, cooked, fumed, and fried food raw materials or final food products and can also be found in critical concentrations in vegetable heat-treated oils. This report will concentrate on the formation of PAH in fried vegetable oils and their effect on human health and will bring information and experimental results on the effect of a novel technology invented by Beyond Oil that by specific simple filtration of oil prior, or during repeatable frying is reducing the conditions and reagents that may lead to incomplete combustion of frying oils and thereafter can reduce the formation of PAHs and AAs.

The major components of PAH isolated in food products are illustrated in Figure 4a, and the three major PAH compounds isolated and determined in vegetable oils are shown in Figure 4b:

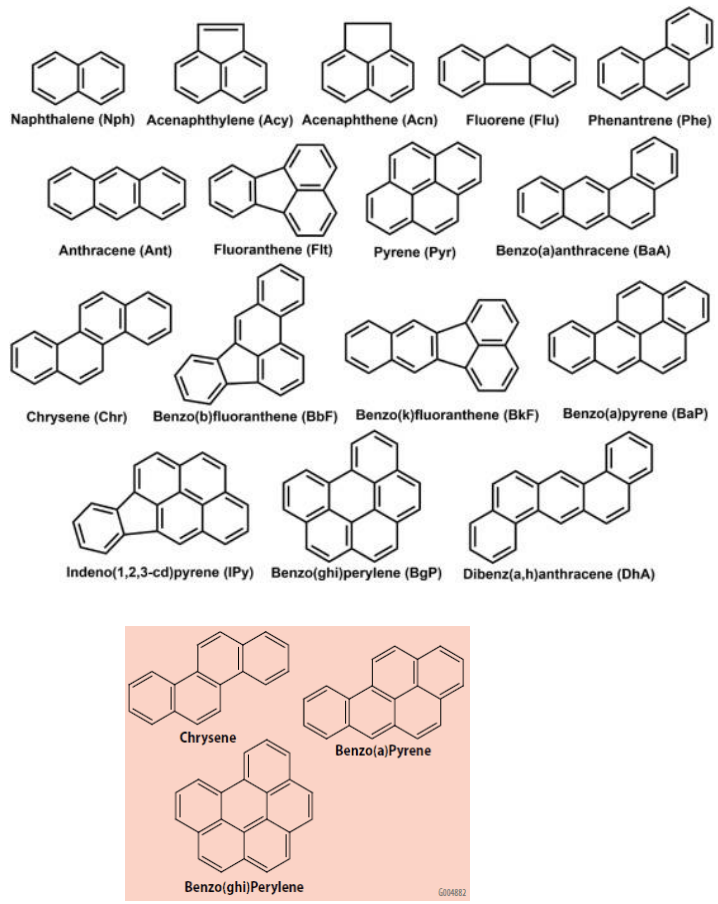

Figure 4: Chemical structures of: a) typical PAHs; and b) the three main structures detected in most food sand fried oils.

PAHs, being lipophilic compounds, generally have very poor aqueous solubility. PAHs accumulate in the lipid tissue of plants, animals, and human tissues. PAH will not tend to accumulate in plant tissues with a high-water content and will exhibit very limited transfer from the soil to the root vegetables. Therefore, it was proven that many of the sources of PAH are heat-treated raw materials during the food frying processes and sources of vegetable oils (corn, sunflower, peanuts, soya, cotton, nuts, coconut, palm, etc.), since they consist of unsaturated fatty acids that are a good source for their partial combustion and the PAH formation.

In 2005, the European Union Commission Regulation (EC) No 208/2005 set maximum limits for PAHs in food. For oils and fats intended for direct human consumption, the maximum residue limit as benzo(a)pyrene on wet weight is 2µg/kg. Edible oils were particularly difficult to analyze because the oil matrix is very complex. Yet, recent advanced analytical tools were able to demonstrate the existence of several polycyclic compounds that were not detected in the past. Therefore, the limits on the PAH levels were set for oils also to 2µg/kg.

3. PAH and Frying Oil.

Re-frying in restaurants for several days in the same oil is one of the main sources of PAH formation. Contamination of vegetable oils with PAH usually occurs during repeatable heating to very high temperatures.

Researchers and health experts in an official document discussed and stressed the hazardous effects of PAH, and included data on identification, characterization, and distribution in our body, its elimination and excretion, and short- and long-term toxicity and carcinogenicity and other effects on human immune systems. (Scientific Committee on Food SCF/CS/CNTM/PAH/29 ADD1, 2002).

The existence of PAH in vegetable oils and in cooking oil and frying oils is also discussed in: "J Food Products, 2006 Jan;69(1):199-204 entitled: "Polycyclic aromatic hydrocarbons in frying oils and snacks". In summary, the authors explain that the high

incidence of lung cancer observed among Chinese women has been associated with exposure to fumes from cooking oil.

A very large study on the levels of PAH derived from 296 vegetable oils in India demonstrated very significant results. The authors reported that extra-virgin olive oil and refined vegetable oils displayed the highest and lowest PAH levels, respectively. Moreover, the authors indicated that all linseed and safflower oil samples and 90% of coconut oil samples were contaminated with PAHs. Chrysene (Chr) was the most common hydrocarbon in linseed (20.7 µg/kg) and safflower (26.6 µg/kg) oil samples. Benzo[a]pyrene (BaP) was also explored, and it was found in 25.5% of samples, displaying the highest PAH4 contamination in certain vegetable oils (coconut, safflower, and linseed oils). PAH4 was detected in 96% of samples, with levels ranging from undetectable to 14.99µg/kg. Considering the permitted limits established by European Regulation 835/2011, 12% and 28% of samples had unsatisfactory levels of BaP and PAH4, respectively, and the authors attributed these unacceptable results to adulterated oils (repeatable heated frying oil).

The information on Repeated Heating Cooking Oils (RCO) and their fumes was collected by Beyond Oil through a library database and electronic search. RCO is a good source that can generate high levels of various PAH compounds. Consumption of repeatedly heated oils or inhalation of cooking fumes can pose a serious health hazard. Residues of PAH have been reported as carcinogenic. The fumes cause a high incidence of genotoxic, mutagenic, tumorigenic, and various cancers. RCO and its cooking fumes were found to enhance the incidence of aberrant cells, including breaks, fragments, exchanges, and multiple chromosomal damages, and micronuclei in a dose-dependent manner. Furthermore, the large consumption of RCO has been associated with a number of malignancies, including lung, colorectal, breast, and prostate cancers. This review report summarizes the current knowledge on PAHs and addresses recent regulation changes concerning the widespread PAHs contamination in several types of food.

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In another study, the investigators tested whether deep frying with different oils under different conditions leads to the development of PAHs either in the oil or in the fried product. Different oils were used for frying chips and extruded snacks in different industrial plants (continuous frying) at temperatures between 170 and 205 degrees Celsius, and peanut oil was used for frying French fries and fish (discontinuous frying) at temperatures between 160 and 185 degrees Celsius. In all the tested oils, high levels of PAHs were detected.

Many remarkable research studies published in prestigious scientific journals showed that RCOs in food frying processes could generate varieties of compounds, including PAHs and many other new chemical entities. The mechanism by which PAH are formed is yet quite confirmed.

Compounds that have a high potential to cause various cancers through multiple chromosomal damages, and the consumption of them and inhalation of these fumes can pose a serious health hazard. The large consumption of RCO has been associated with a number of cancers, including lung, colorectal, breast, and prostate cancers. Furthermore, even several times of small exposure to these RCOs can endanger health due to their obvious cumulative damage. It was up to these days (with the development of Beyond Oil technology impossible to prevent or completely delay the formation of these substances, and they, always appear in any process of heating oils, and the oil will become harmful, and its consumption will endanger the health. Yet, in recent years and now, with the new technology of Beyond Oil, the formation of carcinogenic compounds can be minimized to almost zero after many repeatable frying processes.

Deep frying of vegetable oils is one of the most common methods of food preparation worldwide. Frying makes the food very appetizing and aromatic, which provides delicious taste. The practice of reusing oils for repeated frying is also common in order to reduce costs. When oils are used in frying, the temperature ranges between 150-190^0 C and it undergoes physicochemical changes such as oxidation, hydrolysis, cyclization, and polymerization, and eventually it partially degrades to volatile and non-volatile compounds. This repeated heating also leads to several unwanted changes in the oil medium: high viscosity, color darkening, smoke point reduction and more. Many studies show that the reheated oils have genotoxic, mutagenic, and carcinogenic potential. Further, long-time studies demonstrate more negative health effects of using the reheated oil for preparing food: increased blood pressure, cardiovascular diseases,

atherosclerosis, endothelial dysfunction, and elevated LDL-cholesterol and lipid peroxidation.

It is well recognized that the only way to keep RCO healthy lies in the complete or partial removal of these substances (PAHs and Acrylamide), on a daily basis, from the oil before starting heating for frying. In this way, the oil will keep low values of these carcinogenic substances, and it can be consumed safely. However, with the invention of the Beyond Oil formula, a daily replacement of the frying oils is no longer needed, and the quality of the oils remains within very high standards and can be reused for 15-50 days without replacement (depending on the type of fried food and the type of oil).

Therefore, effective measures involving different food processing strategies are needed to prevent and reduce PAH contamination, thereby decreasing human exposure and detrimental health effects. Furthermore, gaps in the literature have been addressed to provide a basis for future studies.

In order to better understand the real value of treating frying oils with the "Novel Powder of Beyond Oil", the report will elaborate on various physiochemically pathways and reactions that occur during frying. Deep-oil frying produces desirable and undesirable flavor compounds and changes the stability and quality of the oil through various chemical reactions such as hydrolysis, oxidation, cyclization, polymerization, and more.

4. Chemistry of Deep-Oil Frying Oils

Frying is a process of immersing food in hot oil with contact between oil, air, and food at a high temperature of 150°C to 190°C. The simultaneous heat and mass transfer of oil, food, and air during deep-oil frying produces the desirable and unique quality of fried foods. Frying oil acts as a heat transfer medium and contributes to the texture and flavor of fried food. Frying time, food surface area, moisture content of food, and types of frying oil all influence the amount of absorbed oil to foods. Tocopherols, essential amino acids, and fatty acids also degrade during deep-oil frying.

High frying temperature, number of frying, contents of FFA, polyvalent metals, and unsaturated fatty acids of oil decrease the oxidative stability and flavor quality of oil. The hydrolysis, oxidation, and polymerization of oil are common chemical reactions in frying oil and produce volatile and nonvolatile compounds. Most of the volatile

compounds evaporate, and the remaining volatile compounds in oil undergo further chemical reactions or are absorbed in fried foods. The nonvolatile compounds in the oil change the physical and chemical properties of the oil and the fried foods. Nonvolatile compounds affect the flavor stability, quality, and texture of fried foods during storage. Deep-oil frying decreases the unsaturated fatty acids of oil and increases foaming, color, viscosity, density, specific heat, and contents of FFA, polar materials, and polymeric compounds.

a. Hydrolysis of oil

When food is fried in heated oil, the moisture forms steam with bubbling and gradually sinks as the foods are fried. Water, steam, and oxygen initiate the chemical reactions in the frying oil and food. Water, a weak nucleophile, attacks the ester linkage of triacylglycerols and produces di and monoacylglycerols, glycerol, and FFA. FFA content in frying oil increases with the amount of frying. FFA value is used to monitor the quality of frying oil. Hydrolysis is more preferable in oil with short and unsaturated fatty acids in comparison to oil with long and saturated fatty acids, because short and unsaturated fatty acids are more soluble in water than long and saturated fatty acids. Water from foods is easily accessible to short-chain fats and oils for hydrolysis. Frequent replacement of frying oil with fresh oil slows down the hydrolysis of frying oil. Di- and monoacylglycerols, glycerol, and FFA accelerate the further hydrolysis reaction of oil. Glycerol evaporates at 150°C and the remaining glycerol in oil promotes the production of FFA by hydrolysis, suggesting that the maximum FFA content for frying oil is 0.5%.

b. Oxidation of oil

The oxygen in deep-oil frying reacts with oil. Ordinary oxygen in the air is a di-radical compound. Radical oxygen and radical oil are required for the oxidation of oil. Heat, light, metals, and reactive oxygen species facilitate the radical formation of oil. Polyvalent metals such as Fe^{3+} and Cu^{2+} remove hydrogen protons from oil to form alkyl radicals by an oxidation-reduction mechanism of metals even at low temperatures. Most volatiles are removed from frying oil by steam during deep-oil frying.
The remained volatile compounds in frying oil undergo further reactions such as oxidation, dimerization, and polymerization. Volatile compounds significantly

contribute to the flavor quality of frying oil and fried foods. The high interfacial tension in the frying system breaks steam bubbles and forms a steam blanket over the oil surface. The steam blanket reduces the contact between the oil and oxygen and lowers the oil oxidation. Refined oil usually contains less than 1 ppm of alkaline materials such as sodium or potassium salt of fatty acids. Fresh frying oil should have less than 10 ppm of alkaline materials.

a. Polymerization of oil

The major decomposition products of frying oil are nonvolatile polar compounds and triacylglycerol dimers and polymers. Dimers or polymers are either acyclic or cyclic, depending on the reaction process and the kinds of fatty acids consisting of the oil. The formation of dimers and polymers depends on the oil type, frying temperature, and number of frying sessions. As the number of frying sessions and the frying temperature increase, the amounts of polymers increase. The oil rich in linoleic acid is more easily polymerized during deep oil frying than the oil rich in oleic acid.

The formation of cyclic compounds in frying oil depends on the degree of unsaturation and the frying temperature (increased as the amount of linolenic acid increased). Soybean oil produced tricyclic dimers and bicyclic dimers of linoleate as well as cyclic monomers during deep-oil frying. Polymers formed in deep-oil frying are rich in oxygen, oxidized polymer.

Polymers accelerate further degradation of the oil, increase the oil viscosity, reduce the heat transfer, produce foam during deep oil frying, and develop undesirable color in the food. Polymers also cause the high oil absorption into foods. Polymers are highly conjugated dienes and produce a brown, resin-like residue along the sides of the fryer, where the oil and metals come in contact with oxygen from the air. The resin-like residue is often produced when the oil does not release the moisture.

b. Factors affecting the quality of oil during deep oil frying.

Several important and sometimes difficult to control dominate the factors that affect the quality of the oil during frying. These include the turnover rate of oil, frying time and temperature, type of heating, frying oil composition, initial oil quality, the composition of food to be fried, type of fryer, antioxidants oxygen content that affects the deterioration of oil during deep-fat frying and replenishment of fresh oil. It is clear the

high ratio of fresh oil to total oil provides better frying oil quality, also frequent replenishment of fresh oil decreases the formation of polar compounds, diacylglycerols, and FFA and increases the frying. Life and quality of oils results show that replenishment with fresh oil improved the quality of frying oil only after the 30th frying. The most harmful effects on the quality of the oil are frying time and temperature. Frying time increases the contents of FFA, polar compounds such as triacylglycerol dimers, and oxidized triacylglycerols, dimers, and polymers. The first 20 frying sessions increase the formation of polar compounds (TPM) rapidly.

High frying temperature decreased polymers with peroxide linkage and increased the polymers with ether linkage or carbon-to-carbon linkage. The intermittent heating and cooling of oils cause higher deterioration of oils than continuous heating due to the oxygen solubility increase in the oil when the oil cools down from the frying temperature. For example, 25% of the linoleic acid of the sunflower oil was destroyed in intermittent frying, whereas only 5% was destroyed in continuous frying.

5. Correlation of frying conditions, FFA and TPM

An important fact that was observed by many investigators was that FFA increases the thermal oxidation of oils, and their unsaturation, rather than chain length, and leads to significant effects on thermo-oxidative degeneration. It was also demonstrated that the oxidation rate of oil increased as the content of unsaturated fatty acids of frying oil increased. This explains why corn oil, with less unsaturated fatty acid, is better frying oil than soybean with more unsaturated fatty acids. Note also that the content of linolenic acid is critical to the frying performance, the stability of oil, and the flavor quality of fried food. Total Polar Compounds (TPC) content of sunflower oil (C16:0, 5.3%; C18:0, 4.8%; C18:1, 55.4%; C18:2, 32.4%) and high linolenic canola oil (C16:0, 4.1%; C18:0, 2.2%; C18:1, 69.3%; C18:2, 13.8%; C18:3, 6.8%) after 80-h frying at 190 °C, were as high as 44.6% and 47.5%, respectively. Low linolenic acid (2.5%) in Canola oil produced less FFA and less TPM.

7. Compositions of foods and TPM, acrylamides and PAH

Starch increases the degradation of oil, and amino acids protect the oil from degradation during deep-fat frying. Transition metals such as iron, which is present in meat, were accumulated in the oil during frying, and this increased the rates of oxidation and thermal degradation of oil and the TPM.

Antioxidants slow down the oxidation of oil at room temperature. However, they become less effective at frying temperature due to losses through volatilization or decomposition. The combination of tocotrienols and carotenes decreased the oxidation of oil synergistically during frying dissolved oxygen contents in oil nitrogen or carbon dioxide flushing decreased the dissolved oxygen in oil and reduced the oxidation of oil during deep-fat frying. Carbon dioxide gives better protection from oxidation due to its higher solubility and density than nitrogen, suggesting that a minimum of 15 min of nitrogen or 5 min of carbon dioxide flushing prior to heating decreases the oxidation of oil during deep-fat frying.

8. Replenishment of fresh oil

A high ratio of fresh oil to total oil provides better frying oil quality. Frequent replenishment of fresh oil decreases the formation of polar compounds, diacylglycerols, and FFA and increases the frying life and quality of oils. Results show that replenishment with fresh oil improved the quality of frying oil only after the 30^{th} frying. Frying time increases the contents of FFA, polar compounds such as triacylglycerol dimers and oxidized triacylglycerols, dimers and polymers. The first 20 frying increase the formation of polar compounds rapidly. There was no significant increase of polar compounds after the 30^{th} frying. High frying temperature accelerates thermal oxidation and polymerization of oils.

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High frying temperature decreased polymers with peroxide linkage and increased the polymers with ether linkage or carbon to carbon linkage. The intermittent heating and cooling of oils cause higher deterioration of oils than continuous heating due to the oxygen solubility increase in the oil when the oil cools down from the frying temperature. The 25% of linoleic acid of the sunflower oil was destroyed in the intermittent frying, whereas only the 5% was destroyed in continuous frying.

FFAs increase the thermal oxidation of oils, and their unsaturation rather than chain length led to significant effects on thermo-oxidative degeneration, the oxidation rate of oil increased as the content of unsaturated fatty acids of frying oil increased.

9. Maillard Reaction

Nitrogen or carbon dioxide flushing decreased the dissolved oxygen in oil and reduced the oxidation of oil during deep-fat frying. Carbon dioxide gives better protection from oxidation due to its higher solubility and density than nitrogen, suggesting that a minimum of 15 min of nitrogen or 5 min of carbon dioxide flushing prior to heating decreases the oxidation of oil during deep-fat frying.

The Maillard reaction causes nutrient loss and browning. The intensity of browning is primarily correlated with the losses of lysine, histidine, and methionine. The reaction between epoxy alkanals and proteins produces poly- pyrrolic polymers as well as volatile heterocyclic compounds. Carbonyl compounds formed in lipid oxidation would react with amino acids, especially asparagine and produce acrylamide and decrease the nutritional value and safety of foods. The acrolein formed from oil reacted with asparagine and produced acrylamide in deep-fat frying. Acrylamide formation required the heating temperature of above 100 °C and increased as the temperature increased. Types of oil and addition of silicone had no influence on the acrylamide concentration in foods. Acrolein and carbonyls formed during deep-fat frying are not the main precursors of acrylamide.

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10. How are acrylamide and PAH formed as a result of the increase in FFA and TMP values during frying?

Deep-oil frying causes the hydrolysis, oxidation, and polymerization of the oil. Hydrolysis increases the amount of free fatty acids, mono- and diacylglycerols, and glycerol in oils. Oxidation produces hydroperoxides and then low molecular volatile compounds such as aldehydes, ketones, carboxylic acids, and short-chain alkanes and alkenes. Oxidation occurs at a greater rate than hydrolysis during deep-oil frying. Dimers and polymers are also formed by radical and Diels-Alder reactions.

The high temperatures during frying (180 to 200 C) are catalyzing chain reactions which are initiated by hydrolysis of the triglycerides to unsaturated FFAs that are further oxidized and together with other polar substances are resulting in formation of cyclic condensed structures which are in effect a results of incomplete combustion processes. Acrylamide is a result of set of other parallel reactions that are enhanced by high temperatures.

Edible oil is oxidized during processing and storage via autoxidation and photosensitized oxidation, in which triplet oxygen ($^3O_2$) and singlet oxygen ($^1O_2$) react with the oil, respectively. Lipid hydroperoxides formed by $^3O_2$ are conjugated dienes, whereas $^1O_2$ produces both conjugated and nonconjugated dienes. The hydroperoxides are decomposed to produce off-flavor compounds and the oil quality decreases. Autoxidation of oil is accelerated by FFAs, mono- and diacylglycerols, metals such as iron, and thermally oxidized compounds. Temperature, light, oxygen concentration, oil processing, and fatty acid composition also affect the oxidative stability of edible oil. Figure 2 illustrates in a very simplistic way the stages in the formation of cyclic condensed structures during frying when the oxygen is fully consumed as a result of chain reactions.

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Figure 2- from hydrolysis of triglycerides (oil) to PAH and other decomposition products during prolonged frying.

Many studies attempted to explain how PHA are formed. The key question was how the first aromatic ring formed. In recent publication the different pathways for such formation were speculated and some also supported by data.

The frying quality of oil with high unsaturated fatty acids and FFAs is not as good as oil with low unsaturated fatty acids and FFA. Frying in a fryer with a small surface-to-volume ratio is desirable to slow down the oxidation of frying oil. Tocopherols, BHA, BHT, PG, and TBHQ decrease oil oxidation, but they become less effective at frying temperature. PAH are chemically stable and very poorly degraded by hydrolysis (Howard et al., 1991; cited in IPCS, 1998) but are susceptible to oxidation and photo-degradation in light. PAH half lives in air range from a few hours to days and estimated PAH half lives in soils vary from several months to several years. Abiotic degradation may remove 2-20% of two and three ring PAH in contaminated soils (Park et al., IPCS, 1998). PAH with 4 or more aromatic rings persist in the environment but they are often strongly adsorbed to organic matter. Following degradation, oxidized reaction products may be formed which tend to react with biological components.

11. Health risk from Total Polar Materials in frying oils

TPM are mainly responsible for quality deterioration of deep-fried food [2], which impart undesirable odor, unpleasant color and high viscosity to final products or fried oil [3]. Thus, it is speculated that TPM generated from the frying process of edible oil account also for the unfavorable body health effects.

The effects of TPM in the frying oil, on the lipid metabolism, oxidative stress and cytotoxicity of HepG2 cells were investigated through a series of biochemical methods,

such as oil red staining, real-time polymerase chain reaction (RT-PCR), cell apoptosis and cell arrest.

The harmful effects of frying oil on health have been gradually realized. It was reported that deep-fried oils and oxidized fat may take an unshrinkable responsibility for inducing metabolic syndrome. For instance, frying oils could disturb liver function through inhibiting growth rate, promoting liver enlargement and attenuating detoxification enzymes related with defense mechanisms against in vivo lipid peroxidation.

It was also shown that frying oil could result in further damage on cell function, and thus disturb lipid metabolism which is closely correlated with the key genes involved in β-oxidation, such as *PPARα* (peroxisome proliferators-activated receptor alpha), *ACOX* (acyl-CoA oxidase) and *CPT-1* (carnitine palmitoyltransferase-1). TPM may cause assembling VLDL (very low-density lipoproteins) in the liver, contributing to lipid metabolism. Also, the disorder of lipid metabolism occurred with excessive lipid accumulation and lipid peroxidation, leading to the imbalance of oxidative stress. Dysfunction of lipid metabolism could trigger oxidative stress through nuclear receptors. On the other hand, oxidative stress might trigger the occurrence of cell apoptosis and cycle arrest.

Excessive intake of FFA by HepG2 cells should active lipogenesis-related enzymes, which further promote the production of intracellular lipid [25, 26]. We found TPC could significantly induce lipid accumulation in HepG2 cells and reduce the cell survival, corresponding to the behavior of oxidized oil [27]. Accordingly, we reasoned that TPC would cause lipid accumulation and subsequently affect lipid metabolism, such as metabolic genes and lipid transporter gene. As the regulated genes of lipolysis, *PPARα*, *ACOX* and *CPT1* exert important roles on keeping lipid away from deposition and steatosis [28,29,30,31]. These three investigated genes in HepG2 cells were remarkedly down regulated after the exposure to TPC, providing support for the view that TPC could (at least partly) lead to excessive fat intake. This might be due to the inhibition of β-oxidation in mitochondria.

In conclusion, our results demonstrated that TPC could reduce the HepG2 cell survival and induce lipid accumulation in a dose-dependent manner, accompanying with the down regulation of metabolic genes *PPARα, ACOX* and *CPT1* and up-regulation of lipid transporter gene *MTP*. Oxidative stress in HepG2 cell was also confirmed by means of increasing the production of ROS and MDA but decreasing the activities of antioxidant enzymes (SOD, CAT and GSH). Moreover, TPC was found to induce HepG2 cells apoptosis and to prevent HepG2 cells transition from G0/G1 to G2 phase, demonstrating the occurrence of cytotoxicity. Thus, TPC could cause lipid accumulation and trigger the disorder of lipid metabolism, oxidative stress.

12. Health Risk from PAHs

The International Agency for Research on Cancer (IARC) classifies BaP as a Group 1 Agent, which are carcinogenic to humans, whereas BaA, BbF, and Chr are classified as Group 2B Agents, which are possibly carcinogenic to humans. In addition to IARC, the Joint Food and Agriculture Organization/World Health Organization (FAO/WHO), Scientific Committee on Food (SCF), and European Food Safety Authority (EFSA) also classify and evaluate the carcinogenicity of PAHs according to their occurrence (Zelinkova Z., Wenzl T. The occurrence of 16 EPA PAHs in food. *Polycycle. Aroma. Compd.* 2015; 35:248–284). These organizations classify BaA, Chr, BbF, and BaP as mutagenic, genotoxic, and carcinogenic compounds.

The absorption of PAHs is facilitated by their increased solubility in fats, and their lipophilic nature allows them to bind with the cell membrane. This binding causes structural changes, interfering with normal functions of the cell. Among PAHs, BaP is the most easily solubilized by lipids. This compound may associate with lipid distribution molecules, such as chylomicrons and other lipoproteins, thereby permeating several systems responsible for lipid absorption and distribution and, consequently, promoting its bioaccumulation in tissues and organs that actively participate in these processes, such as the liver and small intestine. More specifically, the distribution of PAHs depends on fatty acids associated with triacyl glycerides, free cholesterol, and phospholipids incorporated in the structure of chylomicrons synthesized by intestinal cells and transported by lymph vessels. This is followed by distribution to tissues, such as skeletal muscle. Several studies and

governmental organizations recognize the carcinogenic potential of PAHs. However, the most appropriate cooking methods and strategies to minimize their formation and contamination in food remain even today unsolved. On the other hand, advances in analytical methods are expected to focus on the development of faster, cheaper, more accurate, and environmentally friendly techniques to detect PAHs.

Figure 4 demonstrates the damage to proteins, DNA, and lipids derived from thermal oxidation (in frying oils) and the formation of PAHs. The continuous exposure to these hazardous compounds may also lead to the development of cancer.

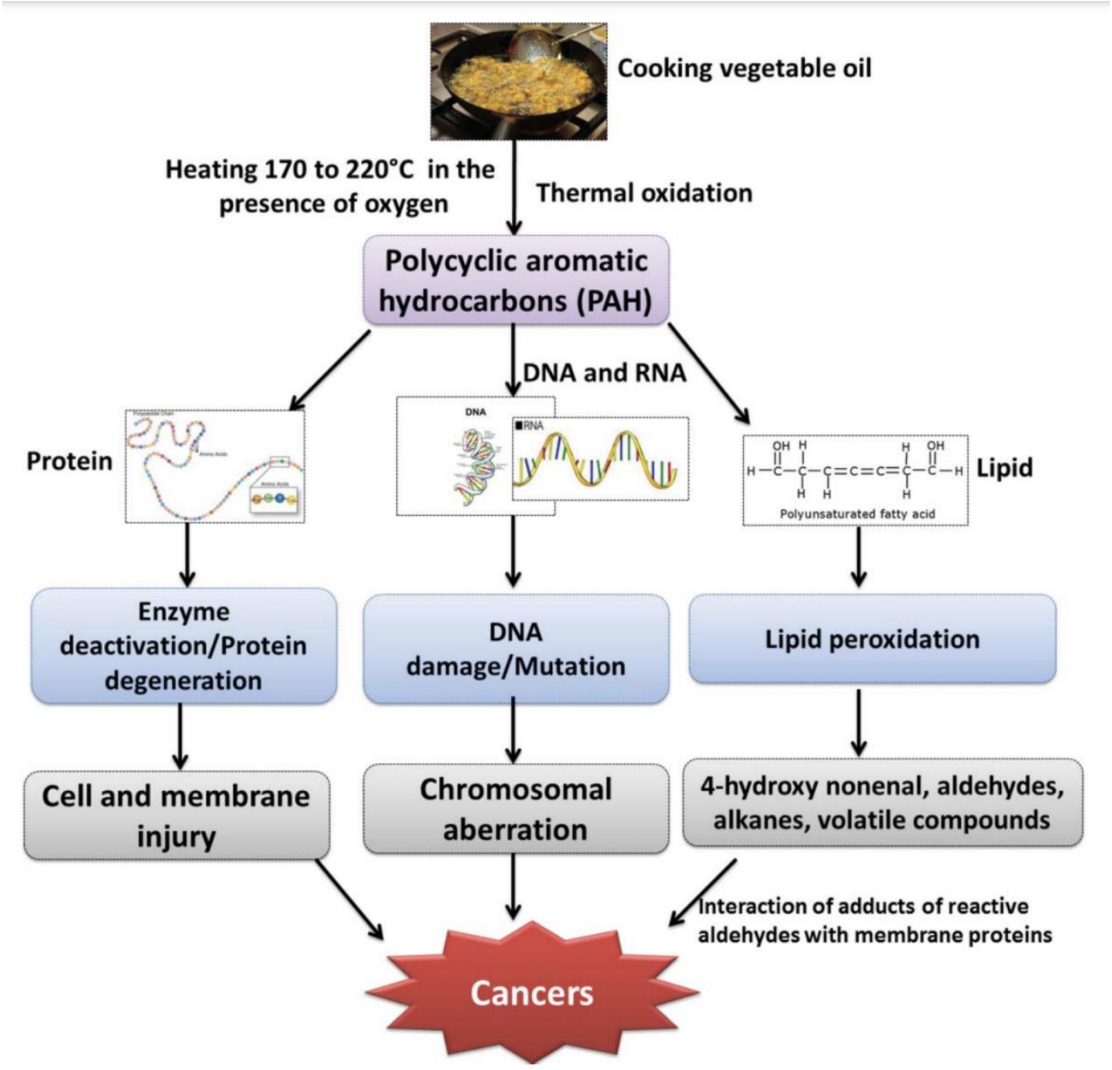

Figure 3: The effect of PAH on proteins, DNA and lipids leading to cancer.

Epidemiological studies have shown that PAHs are associated with reduced lung function, exacerbation of asthma, and increased rates of obstructive lung diseases and cardiovascular diseases. Limited epidemiological evidence also suggests adverse effects on cognitive or behavioral function in children. Figure 4 is demonstrating the risk from inhaling, or oral intake of the PAH compounds.

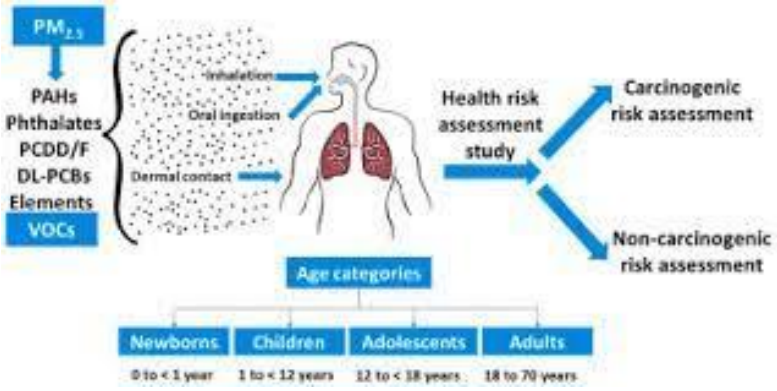

Figure 4- Health risk with the inhaling, or intake of PAH

In a very interesting study, the authors present results from RCO. Harmful health effects from reusing cooking oil can cause an **increase in blood pressure.** It was also demonstrated that PAH, derived from repeated use of fried oil, can result in lipid deposition, oxidative stress, hypertension, atherosclerosis, and other health problems.

In other studies, longer-term exposures to fried oil can be associated with persistent elevations of blood pressure and an elevated prevalence or incidence of hypertension. Recently, a relationship was also identified between background exposures to PAH and variability in heart rate in the general population. Overall, the epidemiological results indicate a potential association between PAHs exposure and human diseases.

In a recent review article in Science, (Vol. 773, 15 June 2021), the authors stressed that "exposure of human and animals to PAHs can lead to a variety of adverse effects, including carcinogenicity and teratogenicity, genotoxicity, reproductive, and endocrine-disrupting effects, immunotoxicity and neurotoxicity". 17 PAH are listed as being the greatest concern. The International Agency for Research lists some PAHs as Cancer initiators (Humans, 2010). Some authors also claim that PAH exposure at the workplace and in the environment may lead to CVD development, such as coronary

artery disease, peripheral arterial disease, stroke, and myocardial infarction (Mallah et al., 2021, 2022).

Figure 5 demonstrates the effect of oxidative stress derived from these carcinogenic molecules and the possible development of CVD lung failure as a result of PAF exposure. The risk of having severe complications if the inhaled quantities of these compounds is very possible.

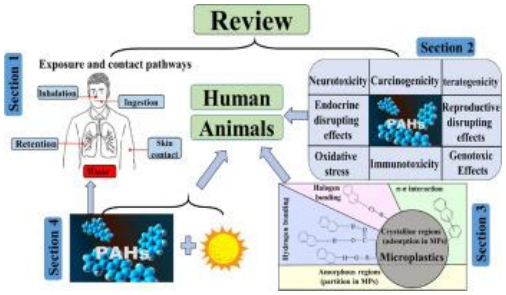

Figure 5- The major risks from the intake of PAH and the systemic oxidative stress

13. What is acrylamide (AA) and Maillard Reaction?

Acrylamide is an organic compound with the chemical structure of CH_2=CHC(O)NH_2. It is a white odorless solid, soluble in water and several organic solvents. From the chemistry perspective, acrylamide is a vinyl substituted as primary amide ($CONH_2$). It is produced industrially mainly as a precursor to polyacrylic amides, which find many uses as water-soluble thickeners and flocculation agents.

Acrylamide has the chemical formula of C_3H_5NO, and its IUPAC name is prop-2-enamide (CH_2=CHC(O)NH_2). It is a white odorless solid, soluble in water and several organic solvents. From the chemistry perspective, acrylamide is a vinyl-substituted primary amide (CONH2).

Aldehydes, epoxides, hydroxyketones, and dicarboxylic compounds formed from the lipid oxidation react with amines, amino acids, and proteins in fried foods by the so-called Maillard reaction.

Acrylamide is a white or colorless, odorless crystalline solid. Acrylamide is stable at room temperature but can violently polymerize at its melting point, or under UV light. Acrid fumes, as well as NOx, may. The Maillard reaction causes nutrient loss and

browning. The intensity of browning is primarily correlated with the losses of lysine, histidine, and methionine. The reaction between epoxy alkanals and proteins produces poly-pyrrolic polymers as well as volatile heterocyclic compounds. Carbonyl compounds formed in lipid oxidation would react with amino acids, especially asparagine, and produce acrylamide and decrease the nutritional value and safety of foods. The acrolein formed from oil reacted with asparagine and produced acrylamide in deep-fat frying. Acrylamide formation required the heating temperature of above 100 °C and increased as the temperature increased. The types of oil and addition of silicone had no influence on the acrylamide concentration in foods. Acrolein and carbonyls formed during deep-fat frying are not the main precursors of acrylamide released when it is heated to decomposition.

14. Health Hazards from Acrylamides

The EPA, International Agency for Research on Cancer (IARC), National Toxicology Program (NTP), and the Department of Health and Human Services have concluded that acrylamide is likely to be carcinogenic to humans.

There are many studies and evidence showing that acrylamide causes cancer of the pancreas in humans, and it has also been shown to cause central nervous system, mammary, scrotum, and other types of cancers.

From a very good and complete review from 2020 in the International Journal of Toxicity, entitled "A Review on Acrylamide in Food: Occurrence, Toxicity, and Mitigation Strategies",it can be concluded that AA is present in a wide range of frequently consumed foods, which makes human exposure to this toxicant unavoidable.
Formation of AA in foods is mainly linked to Maillard reaction, which is the first feasible route that can be manipulated to reduce AA formation. Due to the high exposure to AA, recognition of its toxic effect is necessary, especially in developing countries where awareness about AA health risks is still very low. Therefore, this review also focuses on the different toxic effects of AA exposure, including neurotoxicity, genotoxicity, carcinogenicity, reproductive toxicity, hepatotoxicity, and immunotoxicity.

Humans can be exposed to AA through oral, dermal, and inhalational routes. Acrylamide is also present in nondietary sources such as tobacco smoke, which

is, therefore, another source of exposure for both smokers and nonsmokers (through passive smoking). For smokers, it was found that tobacco smoking is a more prominent source of AA exposure than food. In addition, due to its wide variety of other nonfood industrial uses, many people can be exposed to AA in the workplace through dermal absorption or inhalation. Therefore, AA exposure is a combination of exposures from different sources such as diet, smoking, drinking water, and occupational sources. A very compressive and recent study entitled: "Acrylamide exposure increases cardiovascular risk" on general adult population probably demonstrate the strong effect of AA by inducing oxidative stress, inflammation, and TGF-β1.

A prospective cohort study in Environment International, 164, 2022 stressed that: 1) AA exposure was associated with increased cardiovascular (CV) risk, 2) Long-term daily ACR exposure could longitudinally increase CV risk over 3 years, 3) AA exposure was related to oxidative stress, 4) inflammation, 5) TGF-β1 induction, Oxidative stress, inflammation, and 6) TGF-β1 mediated AA-associated CV risk increase. It was explicitly demonstrated that AA exposure was cross-sectionally and longitudinally associated with increased cardiovascular risk, which was partly mediated by oxidative stress, inflammation, and TGF-β1, providing potent epidemiological evidence for the longitudinal effect of AA exposure on cardiovascular risk increment and crucial mechanistic clues for the involvements of oxidative stress, inflammation, and TGF-β pathway in AA exposure increasing cardiovascular risk.

The findings hinted that AA exposure might increase cardiovascular risk of general adult population by mechanisms of inducing oxidative stress, inflammation, and TGF-β pathway activation.

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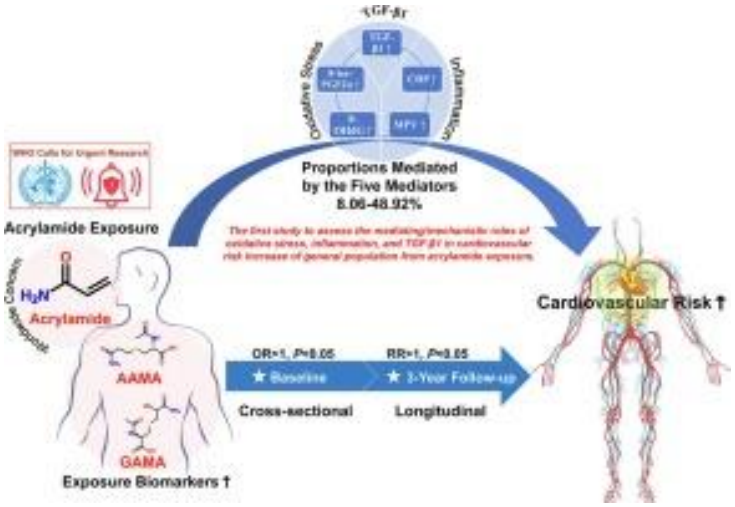

Figure 6 - Cardiovascular risk from exposure to acrylamide

In another interesting work "The Mechanism of Acrylamide-Induced Neurotoxicity: Current Status and Future Perspectives" illustrated (see figure 7) that Acrylamide (ACR), a potential neurotoxin, is produced by the Maillard reaction between reducing sugars and free amino acids during food processing. Over the past decade, the neurotoxicity of ACR has caused increasing concern, prompting many related studies. This review summarized the relevant literature published in recent years and discussed the exposure to occupational, environmental, and daily ACR contamination in food. Moreover, ACR metabolism and the potential mechanism of ACR-induced neurotoxicity were discussed, with particular focus on the axonal degeneration of the nervous system, nerve cell apoptosis, oxidative stress, inflammatory response, and gut-brain axis homeostasis. Additionally, the limitations of existing knowledge, as well as new perspectives, were examined, specifically regarding the connection between the neurotoxicity caused by ACR and neurodegenerative diseases, NOD-like receptor protein 3 (NLRP3) inflammasome-related neuroinflammation, and microbiota-gut-brain axis signaling. This review might provide systematic information for developing an alternative pathway approach to assess ACR risk.

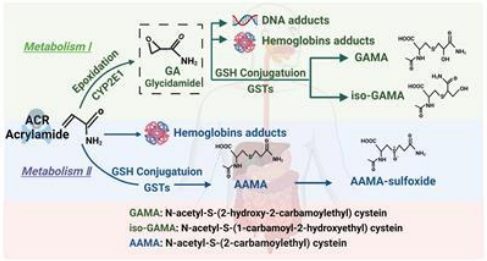

Figure 7: The Mechanism of Acrylamide-Induced Neurotoxicity.

15. On the relationship between total polar components and polycyclic aromatic hydrocarbons in fried edible oil

In a study published in PMID10.1080/19440049.2017.1338835 a correlation between the total polar materials (TPM) and Polycyclic Aromatics (PAHs) was studied in deep-fried dough in various frying oils, including peanut, sunflower, rapeseed, rice bran, soybean, and palm oil. The frying was carried out without any time lag for 32 h (64 batches fried, each for 30 min), and fried oil samples were obtained every 2 h.

The authors used gas chromatography-mass spectrometry (GC-MS) as an analytical tool. The correlations were between TPC and PHA4, including benzo[a]pyrene (BaP), (benzo[a]anthracene, chrysene, benzo[b]fluoranthene, and benzo[a]pyrene) as well as TPC with PAH16 (USEPA 16 PAHs).

The results revealed that the levels of TPC and PAHs in fried oil considerably increased with frying time and the type of oil. The total BaP equivalents (∑BaP eq.) concentrations in fresh oil and in oil whose TPC exceeded 27% were 2.14-13.48 and 5.78-10.80 μg.kg-1, respectively, which means that such correlation is valid and correlated to the carcinogenic potency of frying oil. In addition, the TPC concentration was significantly correlated with the concentrations of the sum of the 16 PAHs, PAH4 and BaP, so that the levels of PAHs could be predicted according to the levels of TPC in fried oil.

16. Beyond Oil Formulation (BOF) and filtration technology for frying oils

Beyond Oil has developed a friendly formula that can, through a simple physical process, collect and virtually eliminate these unwanted compounds, thus keeping the frying oil free of cancer-causing potential for a long period of time. Beyond Oil has a unique, patented, highly sophisticated technology for treating fried vegetable oils (heated, adulterated oils) with a unique, patented "food powder blend" that can reduce the acidity of any vegetable oil to levels close to 0. Recently, Beyond Oil also challenged the problem of preheated oils (after frying) and demonstrated that the issue of risk from the formation of harmful compounds formed in fried oil as a result of repeated frying over several days in the same oil, such as TPM, FFA, PAHs and acrylamides, and health concerns from their formation and/or their presence.

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Beyond Oil has demonstrated in a large number of experiments that the filtration of frying oil every 3 working days will result in a very dramatic change in every measurable parameter. The untreated oil will turn black after 3 frying days, while the treated oil will remain yellowish with practically no color change and with complete transparency. The TPM value will be in average of ca 30 while the treated oil will show a value of 4.5 to 16.5. The FFA will be reduced from over 2 to almost zero or at max 0.8. The oil, after filtration, will have no sedimentation, while the untreated will have a remarkable amount of sedimentation. Similarly, the untreated oil will not pass the sell test, the carefully designed tests, and other visual characteristics. In the following tables, two carefully controlled field tests in restaurants using frying throughout the whole and each day, are shown.

Day Of Filtration	Date	Experiment Sample Z/A	Temp. (CELSIUS)	TPM After filter 08.30	FFA%	Clarity (צלילות)	Frying	Sediments (משקעים)	Color	Smell	Meets the standard
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 3 days of frying without a Beyond Oil filter powder											
1.1	10/12/2022	Z	176	21.8	2.12	Failed	Failed	Failed	Black	Failed	Failed
1	11/12/2022	0	162.6	4.5	0.35	Passed	Passed	Passed	Light Yellow	Passed	Passed
2	12/12/2022	A	144.5	6	0.23	Passed	Passed	Passed	Light Yellow	Passed	Passed
3	13/12/2022	A	144.6	7.5	0.17	Passed	Passed	Passed	Light Yellow	Passed	Passed
4	14/12/2022	A	172	8.5	0.23	Passed	Passed	Passed	Light Yellow	Passed	Passed
5	15/12/2022	A	174	9	0.27	Passed	Passed	Passed	Light Yellow	Passed	Passed
6	16/12/2022	A	176	13.5	0.29	Passed	Passed	Passed	Light Yellow	Passed	Passed
7	17/12/2022	A	146	10.5	0.41	Passed	Passed	Passed	Light Yellow	Passed	Passed
8	18/12/2022	A	174	12.5	0.41	Passed	Passed	Passed	Light Yellow	Passed	Passed
9	19/12/2022	A	144	10.5	0.38	Passed	Passed	Passed	Yellow	Passed	Passed
10	20/12/2022	A	161	11	0.32	Passed	Passed	Passed	Yellow	Passed	Passed
11	21/12/2022	A	171	10.5	0.34	Passed	Passed	Passed	Yellow	Passed	Passed
12	22/12/2022	A	171	12	0.39	Passed	Passed	Passed	Yellow	Passed	Passed
13	23/12/2022	A	174	13.5	0.31	Passed	Passed	Passed	Yellow	Passed	Passed
14	24/12/2022	A	173	13	0.35	Passed	Passed	Passed	Yellow	Passed	Passed
15	25/12/2022	A	171	14	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
16	26/12/2022	A	176	12.5	0.33	Passed	Passed	passed	Yellow	Passed	Passed
17	27/12/2022	A	172	13.5	0.37	Passed	Passed	passed	Yellow	Passed	Passed
18	28/12/2022	A	170	15.5	0.5	Passed	Passed	passed	Golden Yellow	Passed	Passed
19	29/12/2022	A	172	16.5	0.55	Passed	Passed	passed	Golden Yellow	Passed	Passed
20	30/12/2022	A	176	13.5	0.6	Passed	Passed	passed	Golden Yellow	Passed	Passed
21	31/12/2022	A	173	15	0.6	Passed	Passed	passed	Golden Yellow	Passed	Passed
22	1.1.2023	A	175	13	0.7	Passed	Passed	passed	Golden Yellow	Passed	Passed
23	3.1.2023	A	176	14.5	0.58	Passed	Passed	passed	Golden Yellow	Passed	Passed
24	4.1.2023	A	176	14	0.58	Passed	Passed	passed	Golden Yellow	Passed	Passed
25	5.1.2023	A	172	15.5	0.62	Passed	Passed	passed	Golden Yellow	Passed	Passed
26	6.1.2023	A	174	12	0.58	Passed	Passed	passed	Golden Yellow	Passed	Passed
27	7.1.2023	A	153	14.5	0.52	Passed	Passed	passed	Golden Yellow	Passed	Passed
28	8.1.2023	A	169	12.5	0.46	Passed	Passed	passed	Golden Yellow	Passed	Passed
29	9.1.2023	A	172	13.5	0.39	Passed	Passed	passed	Golden Yellow	Passed	Passed
30	10.1.2023	A	175	14	0.43	Passed	Passed	passed	Golden Yellow	Passed	Passed

The results of additional experiments are detailed at the end of the report. appendix 2

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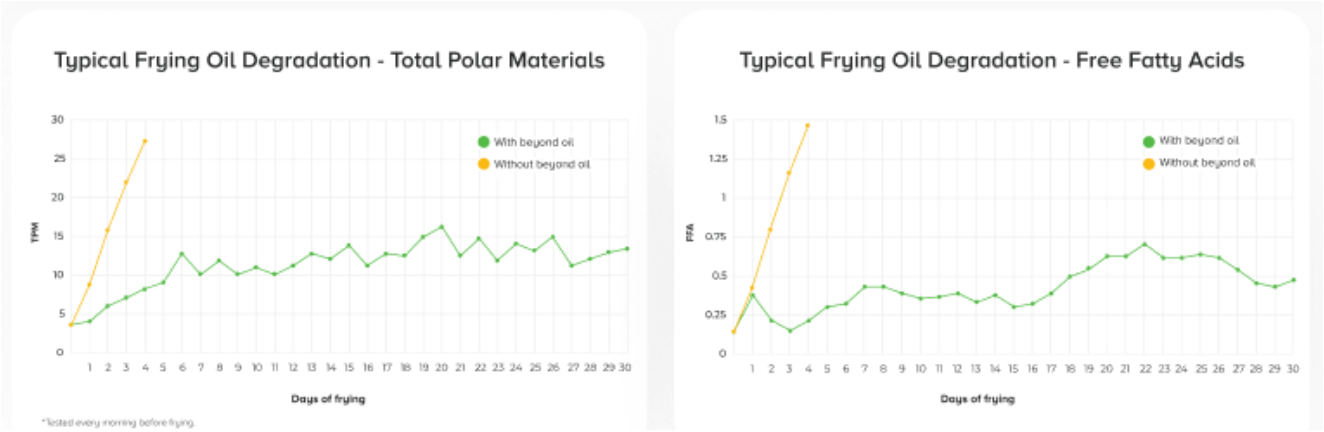
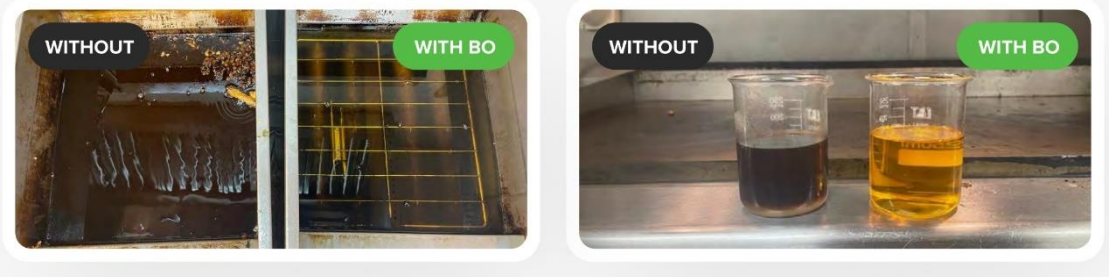
Prof. Nissim Garti, Director



Beyond Oil demonstrates in a set of experiments that while all 9 main PAH compounds, after 4 days of frying in oil in a restaurant (**without using BOF powder**), are detected by chromatographic methods at a total level of 4.29+-0.57 micrograms. / kg of oil. Identical tests were performed, in the same restaurant, for the fried oil, filtered daily, **with BOF powder** for 4 days of frying, all 9 PAH compounds are undetectable, and the total PAH is lower than 0.5 µg/kg c fat. Summarized after analysis by the MERIEUX NUTRASCIENCE company using method MP0998 REV 4 3013, which has the expertise to analyze the PAH compounds.

These results are very convincing and clearly indicate that Beyond Oil has a very significant tool to dramatically improve frying oil that can be repeated and minimize or remove even small amounts of these dangerous compounds and completely eliminate them (almost undetectable).

The analytical results are presented below.



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The Hebrew University of Jerusalem
Casali Institute of Applied Chemistry

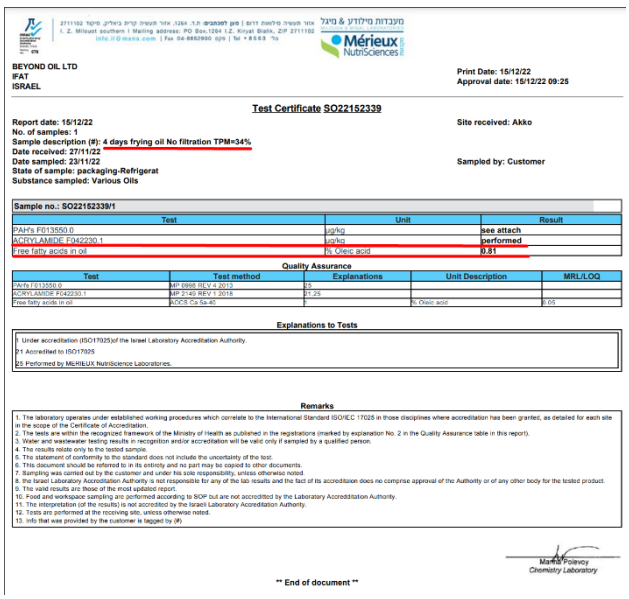
האוניברסיטה העברית בירושלים
מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

The acrylamide levels, using the MP 2149 REV 1 2016 method, were also analyzed by MERIEUX NUTRASCIENCE company (under the accreditation of ISO 01/7025), and the results indicate that the levels in the non-treated oil are very low, yet traces were detected. In the treated and filtered oil, the levels were reduced to non-detectable. The analytical results are attached in Appendix 1. The levels in the non-treated oil are very low, and only traces were detected. In the treated and filtered oil, the levels were reduced to non-detectable. The analytical results are attached below.

Frying oil in a restaurant after 4 days of frying - without using Beyond Oil filter powder

Frying oil in a restaurant after 4 days of frying - with daily use of Beyond Oil filter powder



BEYOND OIL LTD
IFAT
ISRAEL

Print Date: 15/12/22
Approval date: 15/12/22 09:25

Test Certificate SO22152339

Report date: 15/12/22
No. of samples: 1
Sample description (#): 4 days frying oil No filtration TPM=34%
Date received: 27/11/22
Date sampled: 23/11/22
State of sample: packaging-Refrigerat
Substance sampled: Various Oils

Site received: Akko

Sampled by: Customer

Sample no.: SO22152339/1

Test	Unit	Result
PAH's F013550.0	µg/kg	see attach
ACRYLAMIDE F042230.1	µg/kg	performed
Free fatty acids in oil	% Oleic acid	0.81

Quality Assurance

Test	Test method	Explanations	Unit Description	MRL/LOQ
PAH's F013550.0	MP 0998 REV 4 2013	25		
ACRYLAMIDE F042230.1	MP 2149 REV 1 2016	21,25		
Free fatty acids in oil	AOCS Ca 5a-40	1	% Oleic acid	0.05

Explanations to Tests

1. Under accreditation (ISO17025)of the Israel Laboratory Accreditation Authority.
21 Accredited to ISO17025
25 Performed by MERIEUX NutriScience Laboratories.

Remarks

1. The laboratory operates under established working procedures which correlate to the International Standard ISO/IEC 17025 in those disciplines where accreditation has been granted, as detailed for each site in the scope of the Certificate of Accreditation.
2. The tests are within the recognized framework of the Ministry of Health as published in the registrations (marked by explanation No. 2 in the Quality Assurance table in this report).
3. Water and wastewater testing results in recognition and/or accreditation will be valid only if sampled by a qualified person.
4. The results relate only to the tested sample.
5. The statement of conformity to the standard does not include the uncertainty of the test.
6. This document should be referred to in its entirety and no part may be copied to other documents.
7. Sampling was carried out by the customer and under his sole responsibility, unless otherwise noted.
8. the Israel Laboratory Accreditation Authority is not responsible for any of the lab results and the fact of its accreditation does no comprise approval of the Authority or of any other body for the tested product.
9. The valid results are those of the most updated report.
10. Food and workspace sampling are performed according to SOP but are not accredited by the Laboratory Accreditation Authority.
11. The interpretation (of the results) is not accredited by the Israeli Laboratory Accreditation Authority.
12. Tests are performed at the receiving site, unless otherwise noted.
13. Info that was provided by the customer is tagged by (#).

Maria Polevoy
Chemistry Laboratory

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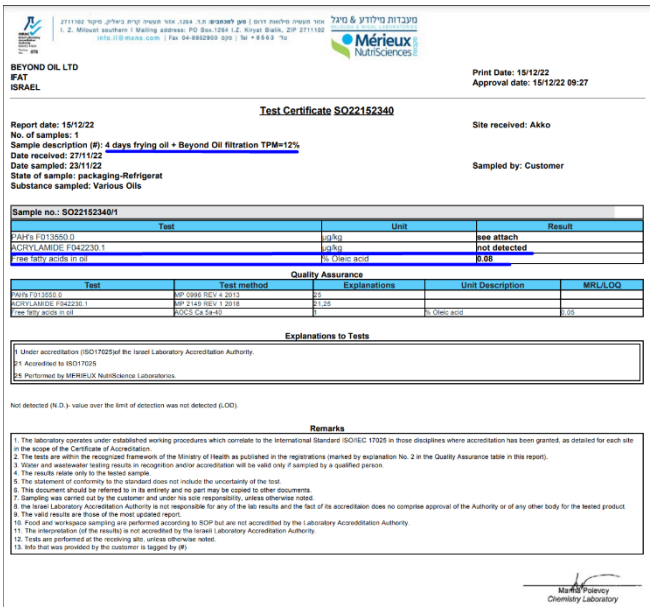


BEYOND OIL LTD
IFAT
ISRAEL

Print Date: 15/12/22
Approval date: 15/12/22 09:27

Test Certificate SO22152340

Report date: 15/12/22
No. of samples: 1
Sample description (#): 4 days frying oil + Beyond Oil filtration TPM=12%
Date received: 27/11/22
Date sampled: 23/11/22
State of sample: packaging-Refrigerat
Substance sampled: Various Oils

Site received: Akko

Sampled by: Customer

Sample no.: SO22152340/1

Test	Unit	Result
PAH's F013550.0	µg/kg	see attach
ACRYLAMIDE F042230.1	µg/kg	not detected
Free fatty acids in oil	% Oleic acid	0.08

Quality Assurance

Test	Test method	Explanations	Unit Description	MRL/LOQ
PAH's F013550.0	MP 0998 REV 4 2013	25		
ACRYLAMIDE F042230.1	MP 2149 REV 1 2016	21,25		
Free fatty acids in oil	AOCS Ca 5a-40	1	% Oleic acid	0.05

Explanations to Tests

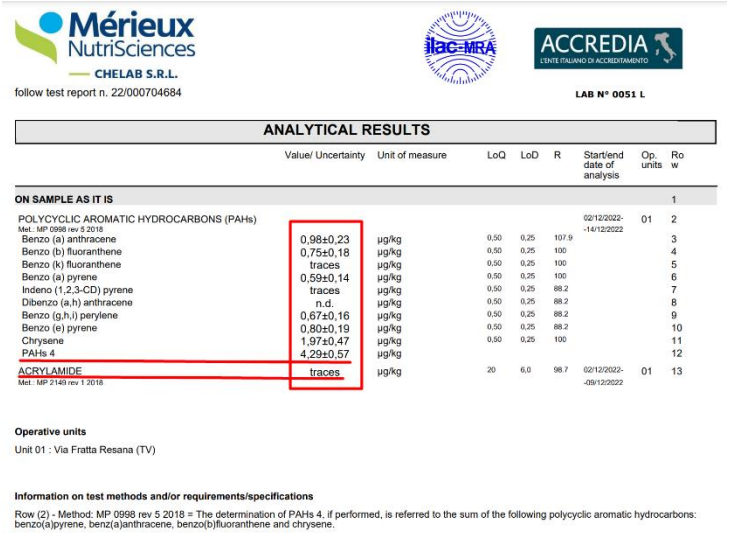
1 Under accreditation (ISO17025)of the Israel Laboratory Accreditation Authority.
21 Accredited to ISO17025
25 Performed by MERIEUX NutriScience Laboratories.

Not detected (N.D.)- value over the limit of detection was not detected (LOD).

Remarks

1. The laboratory operates under established working procedures which correlate to the International Standard ISO/IEC 17025 in those disciplines where accreditation has been granted, as detailed for each site in the scope of the Certificate of Accreditation.
2. The tests are within the recognized framework of the Ministry of Health as published in the registrations (marked by explanation No. 2 in the Quality Assurance table in this report).
3. Water and wastewater testing results in recognition and/or accreditation will be valid only if sampled by a qualified person.
4. The results relate only to the tested sample.
5. The statement of conformity to the standard does not include the uncertainty of the test.
6. This document should be referred to in its entirety and no part may be copied to other documents.
7. Sampling was carried out by the customer and under his sole responsibility, unless otherwise noted.
8. the Israel Laboratory Accreditation Authority is not responsible for any of the lab results and the fact of its accreditation does no comprise approval of the Authority or of any other body for the tested product.
9. The valid results are those of the most updated report.
10. Food and workspace sampling are performed according to SOP but are not accredited by the Laboratory Accreditation Authority.
11. The interpretation (of the results) is not accredited by the Israeli Laboratory Accreditation Authority.
12. Tests are performed at the receiving site, unless otherwise noted.
13. Info that was provided by the customer is tagged by (#).

Maria Polevoy
Chemistry Laboratory



Mérieux NutriSciences
CHELAB S.R.L.
follow test report n. 22/000704684

ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO
LAB N° 0051 L

ANALYTICAL RESULTS

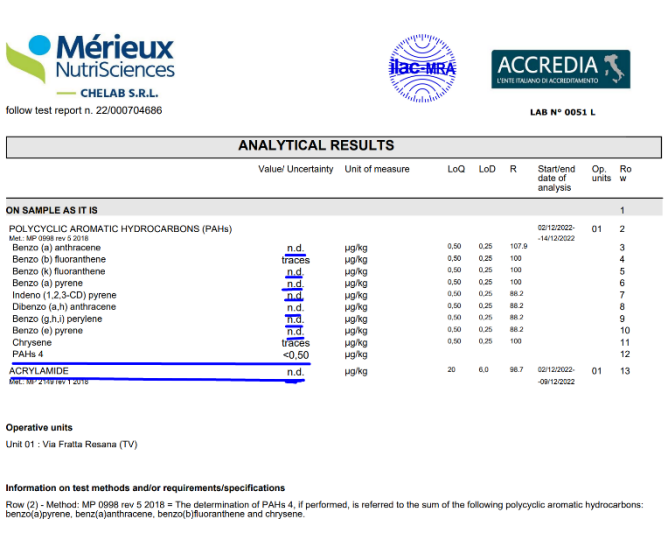
	Value/ Uncertainty	Unit of measure	LoQ	LoD	R	Start/end date of analysis	Op. units	Row
ON SAMPLE AS IT IS								1
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) Met.: MP 0998 rev 5 2018						02/12/2022--14/12/2022	01	2
Benzo (a) anthracene	0,98±0,23	µg/kg	0,50	0,25	107.9			3
Benzo (b) fluoranthene	0,75±0,18	µg/kg	0,50	0,25	100			4
Benzo (k) fluoranthene	traces	µg/kg	0,50	0,25	100			5
Benzo (a) pyrene	0,59±0,14	µg/kg	0,50	0,25	100			6
Indeno (1,2,3-CD) pyrene	traces	µg/kg	0,50	0,25	88.2			7
Dibenzo (a,h) anthracene	n.d.	µg/kg	0,50	0,25	88.2			8
Benzo (g,h,i) perylene	0,67±0,16	µg/kg	0,50	0,25	88.2			9
Benzo (e) pyrene	0,80±0,19	µg/kg	0,50	0,25	88.2			10
Chrysene	1,97±0,47	µg/kg	0,50	0,25	100			11
PAHs 4	4,29±0,57	µg/kg						12
ACRYLAMIDE Met.: MP 2149 rev 1 2018	traces	µg/kg	20	6,0	98.7	02/12/2022--09/12/2022	01	13

Operative units

Unit 01 : Via Fratta Resana (TV)

Information on test methods and/or requirements/specifications

Row (2) - Method: MP 0998 rev 5 2018 = The determination of PAHs 4, if performed, is referred to the sum of the following polycyclic aromatic hydrocarbons: benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene.



Mérieux NutriSciences
CHELAB S.R.L.
follow test report n. 22/000704686

ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO
LAB N° 0051 L

ANALYTICAL RESULTS

	Value/ Uncertainty	Unit of measure	LoQ	LoD	R	Start/end date of analysis	Op. units	Row
ON SAMPLE AS IT IS								1
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) Met.: MP 0998 rev 5 2018						02/12/2022--14/12/2022	01	2
Benzo (a) anthracene	n.d.	µg/kg	0,50	0,25	107.9			3
Benzo (b) fluoranthene	traces	µg/kg	0,50	0,25	100			4
Benzo (k) fluoranthene	n.d.	µg/kg	0,50	0,25	100			5
Benzo (a) pyrene	n.d.	µg/kg	0,50	0,25	100			6
Indeno (1,2,3-CD) pyrene	n.d.	µg/kg	0,50	0,25	88.2			7
Dibenzo (a,h) anthracene	n.d.	µg/kg	0,50	0,25	88.2			8
Benzo (g,h,i) perylene	n.d.	µg/kg	0,50	0,25	88.2			9
Benzo (e) pyrene	n.d.	µg/kg	0,50	0,25	88.2			10
Chrysene	traces	µg/kg	0,50	0,25	100			11
PAHs 4	<0,50	µg/kg						12
ACRYLAMIDE Met.: MP 2149 rev 1 2018	n.d.	µg/kg	20	6,0	98.7	02/12/2022--09/12/2022	01	13

Operative units

Unit 01 : Via Fratta Resana (TV)

Information on test methods and/or requirements/specifications

Row (2) - Method: MP 0998 rev 5 2018 = The determination of PAHs 4, if performed, is referred to the sum of the following polycyclic aromatic hydrocarbons: benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene.

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17. Conclusion

The reuse of frying oil in the food industry has been shown to lead to the formation of cancer-causing compounds such as PAHs and AA in fried food, which poses a significant health risk to consumers.

The BOF technology has demonstrated the ability to decrease the formation of FFA and the polymerization process while reducing the rate of the Diels Adler reaction in the absence of sediments, which include some food proteins. As a result, the BOF technology enables longer turnover of the oil and maintains its critical characteristic properties even after prolonged heating processes and as many as tens of frying cycles.

The BOF technology has been shown to reduce the levels of PAHs and AA significantly, making it a crucial solution in improving the quality of repeatable frying oil while minimizing or removing even small quantities of these hazardous compounds and eliminating them completely. The analytical results of independent labs indicate that the levels of PAH and AA were reduced to non-detectable levels after filtration with the BOF.

Therefore, the BOF technology offers a critical solution to improving the quality of fried food and protecting our health by preventing the development of carcinogenic matter that might lead to various diseases, including cancer.

The many studies and experiments carried out by Beyond Oil in laboratories and restaurants around the world which demonstrate that the new Beyond Oil technology is a game changer in the frying oil industry. By reducing the formation of FFA and the polymerization process, and by reducing the rate of Diels-Alder reactions, the novel powder - BOF enables a longer life cycle of the oil (between 300-1000 percent of the normal frying times) and maintenance of its critical properties, even after prolonged heating and many frying cycles.

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BOF's unique composition is designed to prevent the formation of carcinogenic compounds such as acrylamide and polycyclic aromatic hydrocarbons (PAHs), which are known to cause several health issues, including cancer. The food industry's adoption of BOF can play a vital role in preventing these diseases and ensuring consumer safety.

It can be concluded that the novel BOF is contributing to the quality of fried food and protecting our health, and even preventing the development of carcinogenic matter that might lead to many diseases, including cancer.

It can be concluded that the novel BOF will contribute directly to the reduction of mortality and morbidity (as proven in many studies) from various types of cancer and other diseases caused, in direct connection, by eating fried food, which we eat in restaurants, chips fried in factories and sold to the consumer after passing Semi-fried and fried industrial food such as snacks and more.

By adopting the revolutionary Beyond Oil technology and using the novel powder to reduce the formation of harmful compounds such as TPM, FFA, PAHs and acrylamides, restaurants, food fryers and other food manufacturers can provide safer and healthier food to their customers. Beyond Oil’s innovative solution can help reduce the risk of serious diseases and improve the general health of the population.

In my opinion, the Beyond Oil method is the best physical filtration solution for frying oil in the world. This is a technological innovation that redefines the world of frying oils. This is a global breakthrough technological revolution, which offers an innovative business model based on a socio-economic approach that seeks to contribute to the health of consumers on the one hand and a significant change in terms of the economic aspect of edible oils intended for frying. Technological revolutions require innovative business models - a combination of technology, marketers, frying factories, restaurants, hotels, the final consumer, governments, and international bodies.

The BOF solution is a true game-changer for the frying industry, offering tremendous value to all stakeholders while promoting health and economic benefits. With BOF, Beyond Oil is leading the way in revolutionizing the way we fry our food, improving the quality of life for people worldwide.

One of the most significant benefits of BOF is its impact on health. By reducing the formation of harmful compounds in fried food, BOF ensures that consumers can enjoy their favorite fried foods without compromising their health. With BOF, consumers can have peace of mind knowing that they are not ingesting harmful compounds that can lead to various health problems. This can help to promote a healthier lifestyle and reduce healthcare costs associated with diseases caused by unhealthy diets.

In addition to its health benefits, BOF also offers substantial economic advantages. With BOF, restaurant and factory owners can reduce their oil consumption for frying, leading to significant cost savings. BOF has been shown to extend the lifespan of frying oil, reducing the need for frequent oil changes and reducing maintenance costs. Moreover, the higher quality of fried food produced with BOF can increase customer satisfaction and drive repeat business, further boosting profits.

As a respected scientist who advises some of the world's largest food companies, I can confirm that the problems of Total Polar Material (TPM), Free Fatty Acids (FFA), PAHs, and acrylamides have been recognized problems in the industry for years, without a satisfactory solution to date. However, based on my testing, it appears that Beyond Oil's solution could be the breakthrough that the food industry, especially the frying industry, has been waiting for many years. This is a novel technology that plays a role in reducing the risk of cancer from fried foods.

In my opinion and based on the extensive experience I have in the world of frying, there is no doubt that by switching to the use of Beyond Oil's filter powder formula, we can have a direct and positive impact on reducing mortality and morbidity rates, making the world a healthier place for everyone.

Overall, BOF is a win-win solution for all stakeholders in the frying industry. It resolves the conflict of interest between financial considerations and health concerns by providing a solution that benefits both. With its numerous health and economic benefits, BOF should be adopted as a worldwide standard in the frying industry. Beyond Oil's innovative solution is paving the way for a healthier and more sustainable future, and we should all embrace this technology for the greater good.

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מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

Report compiled by Professor Nissim Garti

Signed- Nissim Garti

Niss— Garti

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Impact of consumption of repeatedly heated cooking oils on the incidence of

various cancers- A critical review, Article *in* Critical Reviews in Food Science and Nutrition · April 2019

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appendix 1

אזור תעשיה מילואות דרום | **מען למכתבים:** ת.ד. 1264, אזור תעשיה קרית ביאליק, מיקוד 2711102
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מעבדות מילודע & מיגל
MILOUDA & MIGAL LABORATORIES
Mérieux NutriSciences

BEYOND OIL LTD
IFAT
ISRAEL

Print Date: 15/12/22
Approval date: 15/12/22 09:27

Test Certificate SO22152340

Report date: 15/12/22
No. of samples: 1
Sample description (#): 4 days frying oil + Beyond Oil filtration TPM=12%
Date received: 27/11/22
Date sampled: 23/11/22
State of sample: packaging-Refrigerat
Substance sampled: Various Oils

Site received: Akko

Sampled by: Customer

Sample no.: SO22152340/1

Test	Unit	Result
PAH's F013550.0	µg/kg	**see attach**
ACRYLAMIDE F042230.1	µg/kg	**not detected**
Free fatty acids in oil	% Oleic acid	**0.08**

Quality Assurance

Test	Test method	Explanations	Unit Description	MRL/LOQ
PAH's F013550.0	MP 0998 REV 4 2013	25		
ACRYLAMIDE F042230.1	MP 2149 REV 1 2018	21,25		
Free fatty acids in oil	AOCS Ca 5a-40	1	% Oleic acid	0.05

Explanations to Tests

1 Under accreditation (ISO17025)of the Israel Laboratory Accreditation Authority.
21 Accredited to ISO17025
25 Performed by MERIEUX NutriScience Laboratories.

Not detected (N.D.)- value over the limit of detection was not detected (LOD).

Remarks

1. The laboratory operates under established working procedures which correlate to the International Standard ISO/IEC 17025 in those disciplines where accreditation has been granted, as detailed for each site in the scope of the Certificate of Accreditation.
2. The tests are within the recognized framework of the Ministry of Health as published in the registrations (marked by explanation No. 2 in the Quality Assurance table in this report).
3. Water and wastewater testing results in recognition and/or accreditation will be valid only if sampled by a qualified person.
4. The results relate only to the tested sample.
5. The statement of conformity to the standard does not include the uncertainty of the test.
6. This document should be referred to in its entirety and no part may be copied to other documents.
7. Sampling was carried out by the customer and under his sole responsibility, unless otherwise noted.
8. the Israel Laboratory Accreditation Authority is not responsible for any of the lab results and the fact of its accreditaion does no comprise approval of the Authority or of any other body for the tested product.
9. The valid results are those of the most updated report.
10. Food and workspace sampling are performed according to SOP but are not accreditted by the Laboratory Accredditation Authority.
11. The interpretation (of the results) is not accredited by the Israeli Laboratory Accreditation Authority.
12. Tests are performed at the receiving site, unless otherwise noted.
13. Info that was provided by the customer is tagged by (#)

Marina Polevoy
Chemistry Laboratory

**** End of document ****

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קמפוס גבעת רם, ירושלים 91904
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Mérieux NutriSciences — CHELAB S.R.L.

ilac-MRA ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO

LAB N° 0051 L

TEST REPORT N. 22/000704686

date of issue 14/12/2022

Customer ID 0073405

Messrs
MILOUDA & MIGAL LABORATORIES LIMITED PARTNERSHIP
I.Z MILOUOT SOUTHERN, ACRE
25201 MILOUOT
Israele

Sample information

Acceptance number	22.544175.0006
Delivered by	DHL International on 01/12/2022
Receiving Date	01/12/2022
Place of origin	MILOUDA & MIGAL LABORATORIES LIMITED PARTNERSHIP I.Z MILOUOT SOUTHERN, ACRE 25201 MILOUOT Israele
Sample Description	SO22152340 - PO22004373 -

Sampling information

Sampled by	Customer

Givat Ram Campus, Jerusalem 91904
Tel: 972-2-6586574/5; Fax: 972-2-6520262
E-mail: GARTI@VMS.HUJI.AC.IL

קמפוס גבעת רם, ירושלים 91904
טלפון: 02-6586574/5; פקס: 02-6520262

Mérieux NutriSciences — CHELAB S.R.L.

follow test report n. 22/000704686

LAB N° 0051 L

ANALYTICAL RESULTS

	Value/ Uncertainty	Unit of measure	LoQ	LoD	R	Start/end date of analysis	Op. units	Row
ON SAMPLE AS IT IS								1
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) Met.: MP 0998 rev 5 2018						02/12/2022--14/12/2022	01	2
Benzo (a) anthracene	n.d.	µg/kg	0,50	0,25	107.9			3
Benzo (b) fluoranthene	traces	µg/kg	0,50	0,25	100			4
Benzo (k) fluoranthene	n.d.	µg/kg	0,50	0,25	100			5
Benzo (a) pyrene	n.d.	µg/kg	0,50	0,25	100			6
Indeno (1,2,3-CD) pyrene	n.d.	µg/kg	0,50	0,25	88.2			7
Dibenzo (a,h) anthracene	n.d.	µg/kg	0,50	0,25	88.2			8
Benzo (g,h,i) perylene	n.d.	µg/kg	0,50	0,25	88.2			9
Benzo (e) pyrene	n.d.	µg/kg	0,50	0,25	88.2			10
Chrysene	traces	µg/kg	0,50	0,25	100			11
PAHs 4	<0,50	µg/kg						12
ACRYLAMIDE Met.: MP 2149 rev 1 2018	n.d.	µg/kg	20	6,0	98.7	02/12/2022--09/12/2022	01	13

Operative units

Unit 01 : Via Fratta Resana (TV)

Information on test methods and/or requirements/specifications

Row (2) - Method: MP 0998 rev 5 2018 = The determination of PAHs 4, if performed, is referred to the sum of the following polycyclic aromatic hydrocarbons: benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene.

information provided by the client

Sampled by: Customer
Place of origin: MILOUDA & MIGAL LABORATORIES LIMITED PARTNERSHIP I.Z MILOUOT SOUTHERN, ACRE 25201 MILOUOT Israele
Description: SO22152340 - PO22004373 -

Chemical responsible
Dott. Emiliano Castellano Chimico Ordine dei Chimici e dei Fisici della Toscana. N. 1631 - Sez. A
Num. certificato 20956661 emesso dall'ente certificatore ArubaPEC S.p.A. NG CA 3, ArubaPEC S.p.A., IT

Mérieux NutriSciences
CHELAB S.R.L.

follow test report n. 22/000704686

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LAB N° 0051 L

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END OF THE TEST REPORT

CHELAB S.r.l. Socio Unico, Company subject to the direction and coordination of Mérieux NutriSciences Corporation
Head office: Via Fratta 25 31023 Resana, Italy Phone. + 39 0423.7177 / Fax + 39 0423.715058 www.merieuxnutrisciences.com/it
VAT nr. 01500900269, R.E.A Treviso n. 156079 Fully paid up € 103.480,00.

The Hebrew University of Jerusalem
Casali Institute of Applied Chemistry

האוניברסיטה העברית בירושלים
מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

אזור תעשיה מילואות דרום | **מען למכתבים:** ת.ד. 1264, אזור תעשיה קרית ביאליק, מיקוד 2711102
I. Z. Milouot southern I Mailing address: PO Box.1264 I.Z. Kiryat Bialik, ZIP 2711102
info.il@mxns.com | Fax 04-8852900 פקס | Tel • 8563 טל'

מעבדות מילודע & מיגל
MILOUDA & MIGAL LABORATORIES
Mérieux NutriSciences

BEYOND OIL LTD
IFAT
ISRAEL

Print Date: 15/12/22
Approval date: 15/12/22 09:25

Test Certificate SO22152339

Report date: 15/12/22
No. of samples: 1
Sample description (#): 4 days frying oil No filtration TPM=34%
Date received: 27/11/22
Date sampled: 23/11/22
State of sample: packaging-Refrigerat
Substance sampled: Various Oils

Site received: Akko

Sampled by: Customer

Sample no.: SO22152339/1

Test	Unit	Result
PAH's F013550.0	µg/kg	**see attach**
ACRYLAMIDE F042230.1	µg/kg	**performed**
Free fatty acids in oil	% Oleic acid	**0.81**

Quality Assurance

Test	Test method	Explanations	Unit Description	MRL/LOQ
PAH's F013550.0	MP 0998 REV 4 2013	25		
ACRYLAMIDE F042230.1	MP 2149 REV 1 2018	21,25		
Free fatty acids in oil	AOCS Ca 5a-40	1	% Oleic acid	0.05

Explanations to Tests

1 Under accreditation (ISO17025)of the Israel Laboratory Accreditation Authority.
21 Accredited to ISO17025
25 Performed by MERIEUX NutriScience Laboratories.

Remarks

1. The laboratory operates under established working procedures which correlate to the International Standard ISO/IEC 17025 in those disciplines where accreditation has been granted, as detailed for each site in the scope of the Certificate of Accreditation.
2. The tests are within the recognized framework of the Ministry of Health as published in the registrations (marked by explanation No. 2 in the Quality Assurance table in this report).
3. Water and wastewater testing results in recognition and/or accreditation will be valid only if sampled by a qualified person.
4. The results relate only to the tested sample.
5. The statement of conformity to the standard does not include the uncertainty of the test.
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Mérieux NutriSciences
CHELAB S.R.L.

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LAB N° 0051 L

TEST REPORT N. 22/000704684

date of issue 14/12/2022

Customer ID 0073405

Messrs
MILOUDA & MIGAL LABORATORIES LIMITED PARTNERSHIP
I.Z MILOUOT SOUTHERN, ACRE
25201 MILOUOT
Israele

Sample information

Acceptance number	22.544175.0005
Delivered by	DHL International on 01/12/2022
Receiving Date	01/12/2022
Place of origin	MILOUDA & MIGAL LABORATORIES LIMITED PARTNERSHIP I.Z MILOUOT SOUTHERN, ACRE 25201 MILOUOT Israele
Sample Description	SO22152339 - PO22004373 -

Sampling information

Sampled by	Customer

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Mérieux NutriSciences
CHELAB S.R.L.

follow test report n. 22/000704684

ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO

LAB N° 0051 L

ANALYTICAL RESULTS

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Benzo (b) fluoranthene	0,75±0,18	µg/kg	0,50	0,25	100			4
Benzo (k) fluoranthene	traces	µg/kg	0,50	0,25	100			5
Benzo (a) pyrene	0,59±0,14	µg/kg	0,50	0,25	100			6
Indeno (1,2,3-CD) pyrene	traces	µg/kg	0,50	0,25	88.2			7
Dibenzo (a,h) anthracene	n.d.	µg/kg	0,50	0,25	88.2			8
Benzo (g,h,i) perylene	0,67±0,16	µg/kg	0,50	0,25	88.2			9
Benzo (e) pyrene	0,80±0,19	µg/kg	0,50	0,25	88.2			10
Chrysene	1,97±0,47	µg/kg	0,50	0,25	100			11
PAHs 4	4,29±0,57	µg/kg						12
ACRYLAMIDE Met.: MP 2149 rev 1 2018	traces	µg/kg	20	6,0	98.7	02/12/2022--09/12/2022	01	13

Operative units

Unit 01 : Via Fratta Resana (TV)

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Description: SO22152339 - PO22004373 -

Chemical responsible

Dott. Emiliano Castellano

Chimico
Ordine dei Chimici e dei Fisici della Toscana.
N. 1631 - Sez. A

Num. certificato 20956661 emesso dall'ente certificatore ArubaPEC S.p.A. NG CA 3, ArubaPEC S.p.A., IT

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END OF THE TEST REPORT

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Casali Institute of Applied Chemistry
האוניברסיטה העברית בירושלים
מכון קזאלי לכימיה יישומית
Prof. Nissim Garti, Director

appendix 2

Restaurant, Canada - Filtering with a filtering machine - Armadillo-September 2022

Day Of Filtration	Date	Temp. (CELSIUS)	TPM After filter 08.30	FFA%	Clarity (צלילות)	Frying	Sediments(משקעים)	Color	Smell	Meets the standard
1	11/12/2022	164	3	0.1	Passed	Passed	Passed	Light Yellow	Passed	Passed
2	13/11/2022	170	3.5	0.08	Passed	Passed	Passed	Light Yellow	Passed	Passed
3	14/11/2022	168	4.5	0.15	Passed	Passed	Passed	Light Yellow	Passed	Passed
4	15/11/2022	165	5	0.09	Passed	Passed	Passed	Light Yellow	Passed	Passed
5	16/11/2022	169	4.5	0.1	Passed	Passed	Passed	Light Yellow	Passed	Passed
6	17/11/2022	165	5.5	0.07	Passed	Passed	Passed	Light Yellow	Passed	Passed
7	18/11/2022	163	5	0.12	Passed	Passed	Passed	Light Yellow	Passed	Passed
8	19/11/2022	165	5.5	0	Passed	Passed	Passed	Light Yellow	Passed	Passed
9	20/11/2022	173	5	0.08	Passed	Passed	Passed	Yellow	Passed	Passed
10	21/11/2022	168	6	0.12	Passed	Passed	Passed	Yellow	Passed	Passed
11	22/11/2022	165	5.5	0.13	Passed	Passed	Passed	Yellow	Passed	Passed
12	23/11/2022	175	5	0	Passed	Passed	Passed	Yellow	Passed	Passed
13	24/11/2022	160	7.5	0.18	Passed	Passed	Passed	Yellow	Passed	Passed
14	25/11/2022	163	7	0.07	Passed	Passed	Passed	Yellow	Passed	Passed
15	26/11/2022	164	7	0.1	Passed	Passed	Passed	Yellow	Passed	Passed
16	27/11/2022	162	6	0.09	Passed	Passed	passed	Yellow	Passed	Passed
17	28/11/2022	163	6.5	0.07	Passed	Passed	passed	Yellow	Passed	Passed
18	29/11/2022	172	6	0	Passed	Passed	passed	Golden Yellow	Passed	Passed
19	29/12/2022	164	7.5	0.21	Passed	Passed	passed	Golden Yellow	Passed	Passed
20	30/12/2022	160	7.5	0.22	Passed	Passed	passed	Golden Yellow	Passed	Passed
21	31/12/2022	165	6.5	0.04	Passed	Passed	passed	Golden Yellow	Passed	Passed

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מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

Restaurant - Haifa - Israel - Filtering with a filtering machine - Armadillo- November 2022- January 2023											
Day Of Filtration	Date	Experime Sample Z/A	Temp. (CELSIUS)	TPM After filter 08.30	FFA%	Clarity (צלילות)	Frying	Sediments(משקעים)	Color	Smell	Meets the standard
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 3 days of frying without a Beyond Oil filter powder											
1.1	12/10/2022	Z	176	21.8	2.12	Failed	Failed	Failed	Black	Failed	Failed
1	12/11/2022	0	162.6	4.5	0.35	Passed	Passed	Passed	Light Yellow	Passed	Passed
2	12/12/2022	A	144.5	6	0.23	Passed	Passed	Passed	Light Yellow	Passed	Passed
3	13/12/2022	A	144.6	7.5	0.17	Passed	Passed	Passed	Light Yellow	Passed	Passed
4	14/12/2022	A	172	8.5	0.23	Passed	Passed	Passed	Light Yellow	Passed	Passed
5	15/12/2022	A	174	9	0.27	Passed	Passed	Passed	Light Yellow	Passed	Passed
6	16/12/2022	A	176	13.5	0.29	Passed	Passed	Passed	Light Yellow	Passed	Passed
7	17/12/2022	A	146	10.5	0.41	Passed	Passed	Passed	Light Yellow	Passed	Passed
8	18/12/2022	A	174	12.5	0.41	Passed	Passed	Passed	Light Yellow	Passed	Passed
9	19/12/2022	A	144	10.5	0.38	Passed	Passed	Passed	Yellow	Passed	Passed
10	20/12/2022	A	161	11	0.32	Passed	Passed	Passed	Yellow	Passed	Passed
11	21/12/2022	A	171	10.5	0.34	Passed	Passed	Passed	Yellow	Passed	Passed
12	22/12/2022	A	171	12	0.39	Passed	Passed	Passed	Yellow	Passed	Passed
13	23/12/2022	A	174	13.5	0.31	Passed	Passed	Passed	Yellow	Passed	Passed
14	24/12/2022	A	173	13	0.35	Passed	Passed	Passed	Yellow	Passed	Passed
15	25/12/2022	A	171	14	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
16	26/12/2022	A	176	12.5	0.33	Passed	Passed	passed	Yellow	Passed	Passed
17	27/12/2022	A	172	13.5	0.37	Passed	Passed	passed	Yellow	Passed	Passed
18	28/12/2022	A	170	15.5	0.5	Passed	Passed	passed	Golden Yellow	Passed	Passed
19	29/12/2022	A	172	16.5	0.55	Passed	Passed	passed	Golden Yellow	Passed	Passed
20	30/12/2022	A	176	13.5	0.6	Passed	Passed	passed	Golden Yellow	Passed	Passed
21	31/12/2022	A	173	15	0.6	Passed	Passed	passed	Golden Yellow	Passed	Passed
22	1.1.2023	A	175	13	0.7	Passed	Passed	passed	Golden Yellow	Passed	Passed
23	3.1.2023	A	176	14.5	0.58	Passed	Passed	passed	Golden Yellow	Passed	Passed
24	4.1.2023	A	176	14	0.58	Passed	Passed	passed	Golden Yellow	Passed	Passed
25	5.1.2023	A	172	15.5	0.62	Passed	Passed	passed	Golden Yellow	Passed	Passed
26	6.1.2023	A	174	12	0.58	Passed	Passed	passed	Golden Yellow	Passed	Passed
27	7.1.2023	A	153	14.5	0.52	Passed	Passed	passed	Golden Yellow	Passed	Passed
28	8.1.2023	A	169	12.5	0.46	Passed	Passed	passed	Golden Yellow	Passed	Passed
29	9.1.2023	A	172	13.5	0.39	Passed	Passed	passed	Golden Yellow	Passed	Passed
30	10.1.2023	A	175	14	0.43	Passed	Passed	passed	Golden Yellow	Passed	Passed

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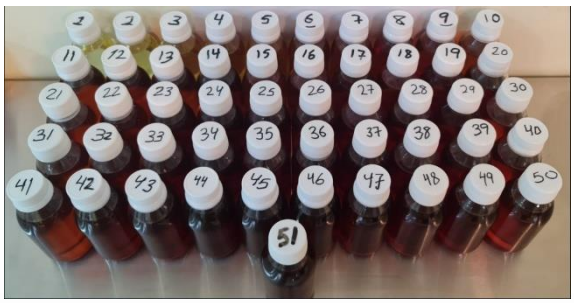
Prof. Nissim Garti, Director

Restaurant - - Israel- December 2022- February 2023

Meets the standard	Smell	Color	Sediments(משקעים)	Frying	Clarity (צלילות)	FFA%	TPM After filter 08.30	זמן ערבוב בדקות	Temp. (CELSIUS)	Experime Sample Z/A	Date	Day Of Filtration
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 2 days of frying												
Failed	Failed	Black	Failed	Failed	Failed				176	Z		1.1
Beginning of an experiment with Beyond Oil - adding powder at night in a special pot - filtering - measuring the night before and in the morning												
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.16	3.5	5	175	0	27/12/2022	1
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.3	3.5	240	170	A	28/12/2022	2
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.1	5.5	60	170	A	29/12/2022	3
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.08	6	60	173	A	30/12/2022	4
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.09	7		175	A	31/12/2022	5
									Closed	A	01/01/2023	
Passed	Passed	Golden Yellow	Passed	Passed	Passed	0.17	8	60	173	A	01/02/2023	6
Passed	Passed	Golden Yellow	Passed	Passed	Passed	0.176	9.5	60	176	A	01/03/2023	7
Passed	Passed	Golden Yellow	Passed	Passed	Passed	0.175	10.5	60	169	A	01/04/2023	8
Passed	Passed	Golden Yellow	Passed	Passed	Passed	0.2	12.5	60	173	A	01/05/2023	9
Passed	Passed	Golden Yellow	Passed	Passed	Passed	0.21	13	60	167	A	01/06/2023	10
Passed	Passed	Light Brown	Passed	Passed	Passed	0.23	12	60	172	A	01/07/2023	11
									Closed	A	01/08/2023	
Passed	Passed	Light Brown	Passed	Passed	Passed	0.21	13.5	60	172	A	01/09/2023	12
Passed	Passed	Light Brown	Passed	Passed	Passed	0.21	18	60	171	A	01/10/2023	13
Passed	Passed	Light Brown	Passed	Passed	Passed	0.24	17.5	60	169	A	01/11/2023	14
Passed	Passed	Light Brown	Passed	Passed	Passed	0.15	10	60	174	A	01/12/2023	15
Passed	Passed	Light Brown	Passed	Passed	Passed	0.2	14	60	175	A	13/1/2023	16
Passed	Passed	Light Brown	Passed	Passed	Passed	0.16	13.5	60	173	A	14/1/2023	17
									Closed	A	15/1/2023	
Passed	Passed	Light Brown	Passed	Passed	Passed	0.176	14	60	170	A	16/1/2023	18
Passed	Passed	Light Brown	Passed	Passed	Passed	0.176	16	60	172	A	17/01/2023	19
Passed	Passed	Light Brown	Passed	Passed	Passed	0.22	17.5	60	164	A	18/01/2023	20
Passed	Passed	Light Brown	Passed	Passed	Passed	0.23	18.5	60	168	A	19/01/2023	21
Passed	Passed	Light Brown	Passed	Passed	Passed	0.4	14	60	171	A	20/01/2023	22
Passed	Passed	Light Brown	Passed	Passed	Passed	0.28	14	60	171	A	21/01/2023	23
									Closed	A	22/01/2023	
Passed	Passed	Light Brown	Passed	Passed	Passed	0.45	14.5	60	170	A	23/01/2023	24
Passed	Passed	Light Brown	Passed	Passed	Passed	0.3	17	60	170	A	24/01/2023	25
Passed	Passed	Light Brown	Passed	Passed	Passed	0.28	17.5	60	168	A	25/01/2023	26
Passed	Passed	Light Brown	Passed	Passed	Passed	0.29	19	60	172	A	26/01/2023	27
Passed	Passed	Light Brown	Passed	Passed	Passed	0.34	19.5	60	171	A	27/01/2023	28
Passed	Passed	Light Brown	Passed	Passed	Passed	0.27	13.5	60	170	A	28/01/2023	29
									Closed	A	29/01/2023	
Passed	Passed	Light Brown	Passed	Passed	Passed	0.28	13.5	60	173	A	30/01/2023	30
Passed	Passed	Light Brown	Passed	Passed	Passed	0.31	16.5	60	172	A	31/01/2023	31
Passed	Passed	Light Brown	Passed	Passed	Passed	0.34	16.5	60	176	A	01/02/2023	32
Passed	Passed	Light Brown	Passed	Passed	Passed	0.38	19.5	60	172	A	02/02/2023	33
Passed	Passed	Light Brown	Passed	Passed	Passed	0.38	21.5	60	171	A	03/02/2023	34
Passed	3.Passed	Light Brown	Passed	Passed	Passed	0.35	15	60	171	A	04/02/2023	35
									Closed	A	05/02/2023	
Passed	Passed	Light Brown	Passed	Passed	Passed	0.36	15	60	171	A	06/02/2023	36
Passed	Passed	Light Brown	Passed	Passed	Passed	0.34	16.5	60	171	A	07/02/2023	37
Passed	Passed	Light Brown	Passed	Passed	Passed	0.35	19	60	171	A	08/02/2023	38
Passed	Passed	Light Brown	Passed	Passed	Passed	0.31	19.5	60	169	A	09/02/2023	39
Passed	Passed	Light Brown	Passed	Passed	Passed	0.32	19	60	167	A	10/02/2023	40
Passed	Passed	Light Brown	Passed	Passed	Passed	0.3	14	60	172	A	11/02/2023	41
									Closed	A	12/02/2023	
Passed	Passed	Light Brown	Passed	Passed	Passed	0.31	13	60	170	A	13/02/2023	42
Passed	Passed	Light Brown	Passed	Passed	Passed	0.29	15	60	168	A	14/02/2023	43
Passed	Passed	Light Brown	Passed	Passed	Passed	0.31	15.5	60	171	A	15/02/2023	44
Passed	Passed	Light Brown	Passed	Passed	Passed	0.34	17	60	170	A	16/02/2023	45
Passed	Passed	Light Brown	Passed	Passed	Passed	0.33	19	60	166	A	17/02/2023	46
Passed	Passed	Light Brown	Passed	Passed	Passed	0.35	15.5	60	170	A	18/02/2023	47
									Closed	A	19/02/2023	
Passed	Passed	Light Brown	Passed	Passed	Passed	0.34	13	60	171	A	20/02/2023	48
Passed	Passed	Light Brown	Passed	Passed	Passed	0.35	14.5	60	172	A	21/02/2023	49
Passed	Passed	Light Brown	Passed	Passed	Passed	0.37	15.5	60	174	A	22/02/2023	50
Passed	Passed	Light Brown	Passed	Passed	Passed	0.37	18	60	171	A	23/02/2023	51



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האוניברסיטה העברית בירושלים
מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

Restaurant - Israel- March-April 2023												
Day Of Filtration	Date	Experiment Sample Z/A	Temp. (CELSIUS)	זמן ערבוב בדקות	TPM After filter 08.30	FFA%	Clarity (צלילות)	Frying	Sediments (משקעים)	Color	Smell	Meets the standard
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 2 days of frying without a Biond filter (sent to recycling)												
1.1		Z	175		23	1.37	Failed	Failed	Failed	Black	Failed	Failed
Beginning of an experiment with Beyond Oil - adding powder at night in a special pot - filtering - measuring the night before and in the morning after filtering Manual mixing with a ladle for a minute												
1	01/03/2023	O	170	1	4.5	0.07	Passed	Passed	Passed	Light Yellow	Passed	Passed
2	02/03/2023	A	169	1	7.5	0.094	Passed	Passed	Passed	Light Yellow	Passed	Passed
3	03/03/2023	A	170	1	9.5	0.088	Passed	Passed	Passed	Light Yellow	Passed	Passed
4	04/03/2023	A	169	1	11	0.12	Passed	Passed	Passed	Light Yellow	Passed	Passed
	05/03/2023	A	Closed									
5	06/03/2023	A	167	1	12	0.14	Passed	Passed	Passed	Light Yellow	Passed	Passed
6	07/03/2023	A	165	1	14	0.15	Passed	Passed	Passed	Light Yellow	Passed	Passed
7	08/03/2023	A	163	1	16	0.16	Passed	Passed	Passed	Light Yellow	Passed	Passed
8	09/03/2023	A	165	1	19	0.21	Passed	Passed	Passed	Light Yellow	Passed	Passed
9	10/03/2023	A	170	1	15	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
10	11/03/2023	A	169	1	15.5	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
	12/03/2023	A	Closed									
11	13/03/2023	A	167	1	11	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
12	14/03/2023	A	175	1	14	0.199	Passed	Passed	Passed	Light Yellow	Passed	Passed
13	15/03/2023	A	164	1	14.5	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
14	16/03/2023	A	165	1	16	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
15	17/03/2023	A	169	1	19.5	0.26	Passed	Passed	Passed	Yellow	Passed	Passed
16	18/03/2023	A	171	1	13	0.19	Passed	Passed	Passed	Yellow	Passed	Passed
	19/03/2023	A	Closed									
17	20/03/2023	A	164	1	13.5	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
18	21/03/2023	A	169	1	16	0.24	Passed	Passed	Passed	Yellow	Passed	Passed
19	22/03/2023	A	169	1	18.5	0.28	Passed	Passed	Passed	Yellow	Passed	Passed
20	23/03/2023	A	171	1	18.5	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
21	24/03/2023	A	169	1	18.5	0.36	Passed	Passed	Passed	Yellow	Passed	Passed
22	25/03/2023	A	170	1	12.5	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
	26/03/2023	A	Closed									
23	27/03/2023	A	166	1	13.5	0.35	Passed	Passed	Passed	Yellow	Passed	Passed
24	28/03/2023	A	166	1	15	0.39	Passed	Passed	Passed	Yellow	Passed	Passed
25	29/03/2023	A	170	1	17	0.4	Passed	Passed	Passed	Yellow	Passed	Passed
26	30/03/2023	A	171	1	15.5	0.34	Passed	Passed	Passed	Yellow	Passed	Passed
27	31/03/2023	A	168	1	17.5	0.35	Passed	Passed	Passed	Yellow	Passed	Passed
28	01/04/2023	A	170	1	16.5	0.37	Passed	Passed	Passed	Yellow	Passed	Passed

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מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

Restaurant - Ifat - Israel- July 2022												
Meets the standard	Smell	Color	Sediments (משקעים)	Frying	Clarity (צלילות)	FFA%	TPM After filter 08.30	Mixing time in minutes	Temp. (CELSIUS)	Experiment Sample Z/A	Date	Day Of Filtration
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 3 days of frying without a Beyond Oil filter powder												
Failed	Failed	Black	Failed	Failed	Failed	1.65	24		170	Z		1.1
Beginning of an experiment with Beyond Oil - Filtering with a filtering machine, armadillo type												
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.09	6.8	10	161	0	26/06/2022	1
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.11	7.4	10	174	A	27/06/2022	2
Passed	Passed	Light	Passed	Passed	Passed	0.13	7.9	10	172	A	28/06/2022	3
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.18	9	10	173	A	05/06/2022	4
Passed	Passed	Yellow	Passed	Passed	Passed	0.2	10	10	175	A	06/06/2022	5
Passed	Passed	Yellow	Passed	Passed	Passed	0.17	11	10	176	A	07/06/2022	6
Passed	Passed	Yellow	Passed	Passed	Passed	0.22	12	10	172	A	08/06/2022	7
Passed	Passed	Yellow	Passed	Passed	Passed	0.26	14	10	170	A	09/06/2022	8
Passed	Passed	Yellow	Passed	Passed	Passed	0.29	14.5	10	168	A	10/06/2022	9
Passed	Passed	Yellow	Passed	Passed	Passed	0.32	13.5	10	174	A	11/06/2022	10
Passed	Passed	Light brown	Passed	Passed	Passed	0.39	15	10	172	A	12/06/2022	11
Passed	Passed	Light brown	Passed	Passed	Passed	0.37	16	10	173	A	13/06/2022	12
Passed	Passed	Brown	Passed	Passed	Passed	0.33	14	10	167	A	14/06/2022	13
Passed	Passed	Brown	Passed	Passed	Passed	0.35	12.5	10	168	A	15/06/2022	14
Passed	Passed	Brown	Passed	Passed	Passed	0.39	14	10	175	A	16/06/2022	15
Passed	Passed	Brown	Passed	Passed	Passed	0.42	17	10	176	A	17/06/2022	16
Passed	Passed	Brown	Passed	Passed	Passed	0.44	15	10	172	A	18/06/2022	17
Passed	Passed	Brown	Passed	Passed	Passed	0.38	17	10	170	A	19/06/2022	18
Passed	Passed	Brown	Passed	Passed	Passed	0.39	17	10	168	A	20/06/2022	19
Passed	Passed	Brown	Passed	Passed	Passed	0.33	15	10	172	A	21/06/2022	20
Passed	Passed	Brown	Passed	Passed	Passed	0.38	15	10	171	A	22/06/2022	21
Passed	Passed	Brown	Passed	Passed	Passed	0.39	15	10	170	A	23/06/2022	22
Passed	Passed	Brown	Passed	Passed	Passed	0.36	17	10	168	A	24/06/2022	23

Restaurant - Yifat - Israel- December 2022- January 2023													
Meets the standard	Smell	Color	Sediments(משקעים)	Frying	Clarity (צלילות)	FFA%	TPM After filter 08.30	TPM Before filter- 23.30	Mixing time - in minutes	Temp. (CELSIUS)	Experime Sample Z/A	Date	Day Of Filtration
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 3 days of frying without a Beyond													
Failed	Failed	Black	Failed	Failed	Failed		1.43	24		175	Z	23/12/2022	1.1
Beginning of an experiment with Beyond Oil - adding powder at night in a special pot - measuring the night before and in the morning after filtering													
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.18	6			173	0	24/12/2022	1
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.07	5.5	6	5	171	A	25/12/2022	2
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.16	7.5	8.5	30	172	A	26/12/2022	3
Passed	Passed	Light Yellow	Passed	Passed	passed	0.23	10	13.5	30	179.1	A	27/12/2022	4
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.23	13.5	14.5	120	175	A	28/12/2022	5
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.27	14	17.5	30	174	A	29/12/2022	6
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.6	14.5	18.5	חצי דקה	170	A	30/12/2022	7
Passed	Passed	Yellow	Passed	Passed	Passed	0.35	16	17	1	166	A	31/12/2022	8
Passed	Passed	Yellow	Passed	Passed	Passed	0.44	13.5	18.5	30	167	A	01/01/2023	9
Passed	Passed	Yellow	Passed	Passed	Passed	0.47	14.5	17	30	172	A	02/01/2023	10
Passed	Passed	Yellow	Passed	Passed	Passed	0.52	16	19.5	30	172	A	03/01/2023	11
Passed	Passed	Yellow	Passed	Passed	Passed	0.5	15	18.5	30	178	A	04/01/2023	12
Passed	Passed	Yellow	Passed	Passed	Passed	0.56	15	18.5	30	165	A	05/01/2023	13
Passed	Passed	Golden Yellow	Passed	Passed	Passed	0.63	14	19	30	175	A	06/01/2023	14
Passed	Passed	Golden Yellow	Passed	Passed	Passed	0.51	15.5	18	30	163	A	07/01/2023	15

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מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

Restaurant - Ifat - Israel-January-February- 2023

Day Of Filtration	Date	Experiment Sample Z/A	Temp. (CELSIUS)	זמן ערבוב בדקות	TPM After filter 08.30	FFA%	Clarity (צלילות)	Frying	Sediments (משקעים)	Color	Smell	Meets the standard
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 3 days of frying without a Beyond Oil filter powder												
1.1		Z	176		25	1.54	Failed	Failed	Failed	Black	Failed	Failed
Beginning of an experiment with Beyond Oil - manual mixing in a special pot - filtering outside the fryer												
1	23/01/2023	0	168	1	4.5	0.17	Passed	Passed	Passed	Light Yellow	Passed	Passed
2	24/01/2023	A	170	1	6.5	0.16	Passed	Passed	Passed	Light Yellow	Passed	Passed
3	25/01/2023	A	168	1	9	0.19	Passed	Passed	Passed	Light Yellow	Passed	Passed
4	26/01/2023	A	170	1	12	0.27	Passed	Passed	Passed	Light Yellow	Passed	Passed
5	27/01/2023	A	172	1	14	0.21	Passed	Passed	Passed	Yellow	Passed	Passed
6	28/01/2023	A	169	1	15.5	0.5	Passed	Passed	Passed	Yellow	Passed	Passed
7	29/01/2023	A	170	1	15.5	0.43	Passed	Passed	Passed	Yellow	Passed	Passed
8	**30/01/2023**	A	168	1	13.5	0.41	Passed	Passed	Passed	Yellow	Passed	Passed
9	31/01/2023	A	169	1	14.5	0.48	Passed	Passed	Passed	Yellow	Passed	Passed
10	01/02/2023	A	170	1	17	0.43	Passed	Passed	Passed	Yellow	Passed	Passed
11	02/02/2023	A	170	1	16	0.39	Passed	Passed	Passed	Light brown	Passed	Passed
12	03/02/2023	A	168	1	17	0.43	Passed	Passed	Passed	Light brown	Passed	Passed
13	**04/02/2023**	A	161	1	13	0.34	Passed	Passed	Passed	Brown	Passed	Passed
14	05/02/2023	A	174	1	15	0.35	Passed	Passed	Passed	Brown	Passed	Passed
15	06/02/2023	A	172	1	17	0.38	Passed	Passed	Passed	Brown	Passed	Passed
16	07/02/2023	A	173	1	18	0.43	Passed	Passed	Passed	Brown	Passed	Passed
17	08/02/23	A	167	1	17	0.48	Passed	Passed	Passed	Brown	Passed	Passed
18	09/02/2023	A	169	1	15	0.44	Passed	Passed	Passed	Brown	Passed	Passed
19	**10/02/2023**	A	171	1	17	0.47	Passed	Passed	Passed	Brown	Passed	Passed
20	11/02/2023	A	174	1	14	0.35	Passed	Passed	Passed	Brown	Passed	Passed
		A										

Restaurant - Israel-May 2022

Meets the standard	Smell	Color	Sediments (משקעים)	Frying	Clarity (צלילות)	FFA%	TPM After filter 08.30	Mixing time in minutes	Temp. (CELSIUS)	Experiment Sample Z/A	Date	Day Of Filtration
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 3 days of frying without a Beyond Oil filter powder												
Failed	Failed	Black	Failed	Failed	Failed	1.87	28		168	Z		1.1
Beginning of an experiment with Beyond Oil - Filtering with a filtering machine, armadillo type												
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.29	7.4	10	169	0	01/05/2022	1
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.19	7.9	10	170	A	02/05/2022	2
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.21	9	10	170	A	03/05/2022	3
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.27	11	10	168	A	04/05/2022	4
Passed	Passed	Yellow	Passed	Passed	Passed	0.2	10	10	167	A	05/05/2022	5
Passed	Passed	Yellow	Passed	Passed	Passed	0.29	12.5	10	169	A	06/05/2022	6
Passed	Passed	Yellow	Passed	Passed	Passed	0.27	11.5	10	171	A	07/05/2022	7
Passed	Passed	Yellow	Passed	Passed	Passed	0.4	13.5	10	174	A	08/05/2022	8
Passed	Passed	Yellow	Passed	Passed	Passed	0.42	14.5	10	170	A	09/05/2022	9
Passed	Passed	Yellow	Passed	Passed	Passed	0.43	15	10	172	A	10/05/2022	10
Passed	Passed	Light brown	Passed	Passed	Passed	0.39	17	10	170	A	11/05/2022	11
Passed	Passed	Light brown	Passed	Passed	Passed	0.37	16	10	168	A	12/05/2022	12
Passed	Passed	Brown	Passed	Passed	Passed	0.34	12	10	161	A	13/05/2022	13
Passed	Passed	Brown	Passed	Passed	Passed	0.36	14	10	174	A	14/05/2022	14
Passed	Passed	Brown	Passed	Passed	Passed	0.39	16	10	172	A	15/05/2022	15
Passed	Passed	Brown	Passed	Passed	Passed	0.43	17	10	173	A	16/05/2022	16
Passed	Passed	Brown	Passed	Passed	Passed	0.47	18	10	167	A	17/05/2022	17
Passed	Passed	Brown	Passed	Passed	Passed	0.43	16	10	168	A	18/05/2022	18
Passed	Passed	Brown	Passed	Passed	Passed	0.42	17	10	175	A	19/05/2022	19
Passed	Passed	Brown	Passed	Passed	Passed	0.34	15	10	176	A	20/05/2022	20

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מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

Restaurant - Israel-2022 מרץ												
Meets the standard	Smell	Color	Sediments(משקעים)	Frying	Clarity (צלילות)	FFA%	TPM After filter 08.30	Mixing time in minutes	Temp. (CELSIUS)	Experiment Sample Z/A	Date	Day Of Filtration
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 3 days of frying without a Beyond Oil filter powder												
Failed	Failed	Black	Failed	Failed	Failed	1.67	24		168	Z		1.1
Beginning of an experiment with Beyond Oil - Filtering with a filtering machine, armadillo type												
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.28	6.9	10	170	0	01/03/2022	1
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.18	7.4	10	170	A	02/03/2022	2
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.2	8.5	10	165	A	03/03/2022	3
Passed	Passed	Light Yellow	Passed	Passed	Passed	0.24	8	10	167	A	04/03/2022	4
Passed	Passed	Yellow	Passed	Passed	Passed	0.2	11	10	168	A	05/03/2022	5
Passed	Passed	Yellow	Passed	Passed	Passed	0.24	9	10	170	A	06/03/2022	6
Passed	Passed	Yellow	Passed	Passed	Passed	0.26	11	10	174	A	07/03/2022	7
Passed	Passed	Yellow	Passed	Passed	Passed	0.25	10	10	173	A	08/03/2022	8
Passed	Passed	Yellow	Passed	Passed	Passed	0.41	13	10	168	A	09/03/2022	9
Passed	Passed	Yellow	Passed	Passed	Passed	0.39	12	10	172	A	10/03/2022	10
Passed	Passed	Light brown	Passed	Passed	Passed	0.44	15	10	169	A	11/03/2022	11
Passed	Passed	Light brown	Passed	Passed	Passed	0.48	15.5	10	166	A	12/03/2022	12
Passed	Passed	Brown	Passed	Passed	Passed	0.35	12.5	10	170	A	13/03/2022	13
Passed	Passed	Brown	Passed	Passed	Passed	0.37	13	10	173	A	14/03/2022	14
Passed	Passed	Brown	Passed	Passed	Passed	0.43	15	10	170	A	15/03/2022	15
Passed	Passed	Brown	Passed	Passed	Passed	0.45	16	10	168	A	16/03/2022	16
Passed	Passed	Brown	Passed	Passed	Passed	0.47	17	10	179	A	17/03/2022	17
Passed	Passed	Brown	Passed	Passed	Passed	0.42	15	10	174	A	18/03/2022	18
Passed	Passed	Brown	Passed	Passed	Passed	0.41	16	10	168	A	19/03/2022	19
Passed	Passed	Brown	Passed	Passed	Passed	0.33	15	10	166	A	20/03/2022	20

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The Hebrew University of Jerusalem
Casali Institute of Applied Chemistry

האוניברסיטה העברית בירושלים
מכון קזאלי לכימיה יישומית

Prof. Nissim Garti, Director

Restaurant - Nahalel - Israel												
Day Of Filtration	Date	Experiment Sample Z/A	Temp. (CELSIUS)	זמן ערבוב בדקות	TPM After filter 08.30	FFA%	Clarity (צלילות)	Frying	Sediments (משקעים)	Color	Smell	Meets the standard
Information - the restaurant's oil is changed every 3 working days - it becomes black and frothy - an example of the oil after 2 days of frying without a Biond filter (sent to recycling)												
1.1		Z	175		33	1.68	Failed	Failed	Failed	Black	Failed	Failed
ng of an experiment with Beyond Oil - adding powder at night in a special pot - filtering - measuring the night before and in the morning after t												
Manual mixing for one minute												
1	01/03/2023	O	170	1	4.5	0.07	Passed	Passed	Passed	Light Yellow	Passed	Passed
2	02/03/2023	A	169	1	7.5	0.094	Passed	Passed	Passed	Light Yellow	Passed	Passed
3	03/03/2023	A	170	1	9.5	0.088	Passed	Passed	Passed	Light Yellow	Passed	Passed
4	04/03/2023	A	169	1	11	0.12	Passed	Passed	Passed	Light Yellow	Passed	Passed
	05/03/2023	A	Closed									
5	06/03/2023	A	167	1	12	0.14	Passed	Passed	Passed	Light Yellow	Passed	Passed
6	07/03/2023	A	165	1	14	0.15	Passed	Passed	Passed	Light Yellow	Passed	Passed
7	08/03/2023	A	163	1	16	0.16	Passed	Passed	Passed	Light Yellow	Passed	Passed
8	09/03/2023	A	165	1	19	0.21	Passed	Passed	Passed	Light Yellow	Passed	Passed
9	10/03/2023	A	170	1	15	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
10	11/03/2023	A	169	1	15.5	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
	12/03/2023	A	Closed									
11	13/03/2023	A	167	1	11	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
12	14/03/2023	A	175	1	14	0.199	Passed	Passed	Passed	Light Yellow	Passed	Passed
13	15/03/2023	A	164	1	14.5	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
14	16/03/2023	A	165	1	16	0.22	Passed	Passed	Passed	Light Yellow	Passed	Passed
15	17/03/2023	A	169	1	19.5	0.26	Passed	Passed	Passed	Yellow	Passed	Passed
16	18/03/2023	A	171	1	13	0.19	Passed	Passed	Passed	Yellow	Passed	Passed
	19/03/2023	A	Closed									
17	20/03/2023	A	164	1	13.5	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
18	21/03/2023	A	169	1	16	0.24	Passed	Passed	Passed	Yellow	Passed	Passed
19	22/03/2023	A	169	1	18.5	0.28	Passed	Passed	Passed	Yellow	Passed	Passed
20	23/03/2023	A	171	1	18.5	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
21	24/03/2023	A	169	1	18.5	0.36	Passed	Passed	Passed	Yellow	Passed	Passed
22	25/03/2023	A	170	1	12.5	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
	26/03/2023	A	Closed									
23	27/03/2023	A	166	1	13.5	0.35	Passed	Passed	Passed	Yellow	Passed	Passed
24	28/03/2023	A	166	1	15	0.39	Passed	Passed	Passed	Yellow	Passed	Passed
25	29/03/2023	A	170	1	17	0.4	Passed	Passed	Passed	Yellow	Passed	Passed
26	30/03/2023	A	171	1	15.5	0.34	Passed	Passed	Passed	Yellow	Passed	Passed
27	31/03/2023	A	168	1	17.5	0.35	Passed	Passed	Passed	Yellow	Passed	Passed
28	01/04/2023	A	170	1	16.5	0.37	Passed	Passed	Passed	Yellow	Passed	Passed
		A	Closed									
29	03/04/2023	A	171	1	18.5	0.47	Passed	Passed	Passed	Yellow	Passed	Passed
30	04/04/2023	A	174	1	17	0.47	Passed	Passed	Passed	Yellow	Passed	Passed
		A	Closed									
		A	Closed									
31	07/04/2023	A	174	1	19	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
32	08/04/2023	A	169	1	20.5	0.41	Passed	Passed	Passed	Yellow	Passed	Passed
33	09/04/2023	A	172	1	19.5	0.37	Passed	Passed	Passed	Yellow	Passed	Passed
34	10/04/2023	A	166	1	19	0.34	Passed	Passed	Passed	Yellow	Passed	Passed
35	11/04/2023	A	171	1	17	0.29	Passed	Passed	Passed	Yellow	Passed	Passed
36	12/04/2023	A	174	1	17	0.37	Passed	Passed	Passed	Yellow	Passed	Passed
37	13/04/2023	A	171	1	16.5	0.38	Passed	Passed	Passed	Yellow	Passed	Passed
38	14\04\2023	A	169	1	20	0.5	Passed	Passed	Passed	Yellow	Passed	Passed
39	15\04\2023	A	169	1	20	0.54	Passed	Passed	Passed	Yellow	Passed	Passed
	16\04\2023	A	Closed									
40	17\04\2023	A	176	1	15	0.32	Passed	Passed	Passed	Yellow	Passed	Passed
41	18\04\2023	A	172	1	14	0.35	Passed	Passed	Passed	Yellow	Passed	Passed
42	19\04\2023	A	165	1	17	0.47	Passed	Passed	Passed	Yellow	Passed	Passed
43	20\04\2023	A	160	1	18.5	0.52	Passed	Passed	Passed	Yellow	Passed	Passed
44	21\04\2023	A	165	1	20.5	0.52	Passed	Passed	Passed	Yellow	Passed	Passed
45	22\04\2023	A	167	1	15	0.38	Passed	Passed	Passed	Yellow	Passed	Passed

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