Risks of Re-frying!

Dr. Sitaram Dixit, Chairman – Consumer Guidance Society of India, CGSI

Indian cooking is synonymous with the use of vegetable oils and ghee since ancient times for enhancing flavour and taste. Indian's broadly cook food with oil either by pan-frying, shallow frying or by deep-frying. In pan-frying, we cook food in a heated pan having a light coating of oil whereas in shallow frying, the oil reaches up to half the level of food in the pan with both the food and oil in unison with the bottom of the pan. In deep-frying, cooking happens in a pan having oil deep enough for the food to float in oil. During deep-frying the oil under use, endures a series of complex reactions like hydrolysis, isomerization, oxidation and polymerization that positively influence the quality of the fried food preparation in terms of flavour, texture, nutrient composition and shelf life even though these very reactions albeit also adversely result in the formation of toxic by-products both in the fried food and oil.

Scientific studies prove that these chemical reactions depend on various factors like quality of oil, anti-oxidants content present in the oil, the quantum of oxygen available during the frying process, the frying conditions (time, temperature, etc.), type of food fried and intermittent replenishment of frying oil by fresh oil. High frying temperatures, increase in the number of times of frying, polyvalent metals in the frying equipment/vessel, presence of free and unsaturated fatty acid content in the oil all contribute in decreasing the frying oil's oxidative stability and thereby, the flavour and long-time keeping quality. Antioxidants like tocopherols, oryzanol, tocotrienols, sesamol, ascorbic acids, etc., naturally present in the vegetable oil along with added synthetics like propyl gallate, tertiary butyl hydroquinone (TBHQ), 1ppm silicone oil, etc., do help in reducing the rate of oxidation; however, its effectiveness diminishes with increasing frying temperature and repeated number of frying.

In pan-frying, the food prepared consumes most of the cooking oil and in shallow frying residual oil present is small. However, in case of deep-frying, the fried food absorbs only a portion of the frying oil leaving behind a substantial amount, enabling us largely for economic considerations to reuse the same cooking oil later. Reheating the cooking oil for deep-frying food, creates free radicals and on eating such fried foods, the free radicals present in the food, attaches itself to healthy body cells leading to potential health risks like throat irritation, hyper-acidity, heart ailment, atherosclerosis, cancer, Alzheimer's disease, Parkinson's disease, etc.

We define the temperature at which an oil breaks down and begins to smoke as "smoke point." Generally, vegetable oils have higher smoke point than animal fat also refined oils have it higher than unrefined oils and every time one re-heats the oil for frying, the smoke point drops. ***Deep-frying takes place at around 190° C and therefore vegetable oils selected for deep-frying should ideally have their smoke point above 190° C.*** Cooking oils like ghee, refined groundnut oil, coconut oil, palm oil, soybean oil, sunflower oil, mustard oil, safflower oil, rice barn oil, olive oil, etc., all have different smoke points. We are aware that cooking oils consists of saturated and unsaturated fatty acids. An oil with high polyunsaturated fatty acids (PUFA) content on heating degrades more rapidly. Foods fried in oils with low PUFA content are tastier. ***Ghee, having a high smoke point and low PUFA content is therefore the best frying oil,*** although the high cost is restrictive for regular use. ***Vanaspati*** *or hydrogenated vegetable oil with a high smoke point* ***is no doubt a cheaper alternative to ghee; however, it is best to avoid it***, due to the obvious presence of toxic trans-fats that negatively affects human health leading to atherosclerosis.

STANDARD COMPOSITION OF POPULAR OILS USED IN INDIA	SMOKE POINT (°C) ~ approx.	SATURATED FATTY ACID (SFA) %	MONO UNSATURATED FATTY ACID (MUFA) %	POLY UNSATURATED FATTY ACID (PUFA) %
Butter	176	~ 60.0	~ 19.0	~ 4.0
Coconut	176	81.0 – 107.3	5.0 – 10.2	1.0 – 2.7
Ghee	232	~ 56.0	~ 21.0	~ 11.0
Mustard	260	1.2 – 12.0	35.5 – 89.0	16.0 – 44.0
Palm	232	43.3 – 57.4	36.0 – 45.0	9.0 – 12.5
Peanut	232	12.0 – 27.8	35.7 – 71.6	12.0 – 43.3
Rice Barn	260	15.3 – 27.8	38.0 – 47.0	33.2 – 42.9
Safflower	232	7.4 – 12.8	8.5 – 23.9	67.8 – 83.3
Sesame	210	12.7 – 17.1	34.4 – 46.1	37.1 – 48.9
Soybean	232	10.1 – 17.1	17.0 – 31.1	52.5 – 70.1
Sunflower	232	8.1 – 17.1	14.0 – 40.4	48.3 – 74.6
Virgin Olive	160	8.0 – 17.1	55.0 – 84.6	3.5 – 22.5
Vanaspati	250	28.0 – 48.0	4.0 – 38.0	1.0 – 41.0
	Values may vary as per sample, origin, oil blend, brand, etc.			

Cooking oils with low PUFA content and high smoke point is ideal for deep-frying. Peanut oil, palm oil, sesame oil, rice barn oil, mustard oil, etc., are suitable and PUFA rich oils like safflower oil, sunflower oil, soybean oil, are unsuitable for deep-frying food. ***Many scientific studies find that reheating PUFA rich oils like soybean, sunflower, safflower, etc., for use produces a toxic chemical 4-hydroxy-trans-2-nonenal (HNE).*** Ingestion of HNE leads to increased risks of cardiovascular diseases, stroke, various types of liver disorders, cancer, Alzheimer's disease, Huntington's disease, Parkinson's disease, etc. HNE reacts with human deoxyribose nucleic acid (DNA), ribose nucleic acid (RNA) and proteins affecting basic human cellular processes.

Simple signs to identify deteriorated cooking oil after use and precautions to take for storage and use.

1. Darkening of oil colour due to burning of food fried.
2. Increase in viscosity (thickness) due to the formation of toxic polymeric compounds.
3. Increase in sedimentation of absorbent fried food particles.
4. Decrease in smoke point during reuse.
5. The oil smells rancid or unpleasant.

Even though it is true that we should not re-heat cooking oils for use, economic concerns, shortage, etc., do not easily permit us this. Therefore, following necessary precautions becomes imperative.

- Strain the used oil free from food particles and store it in a glass jar (polyvalent metals present in metal containers tend to oxidise oil and deteriorate it) in a cool dark place.
- Refrigerating it could prevent rancidity and the formation of anaerobic clostridium botulinum bacteria that causes botulism a potentially fatal food poisoning.
- Ensure to avoid frying food above 190° C or exposing cooking oil to higher temperatures as it leads to the formation of HNE and accumulation of the same in oil and food fried.
- Strictly avoid replenishing the cooking oil in the frying vessel to prevent formation of toxic chemicals.
- Avoid iron or copper frying vessels, as these metals inherently tend to accelerate rancidity of oil.
- ***Do not mix fresh and used cooking oil.***

Disposal of Used Cooking Oil

Proper disposal of deteriorated used cooking oil waste is also very important. However easy it is, one should never pour it in the drain as it can clog drainage pipes posing a safety health hazard by forming a thin layer on water bodies and reservoirs, as oil is lighter than water thereby hindering oxygenation. Experts affirm that even one litre of oil could contaminate one million litres of water. Recycling and re-using the used cooking oil for non-edible use is the ideal way of disposal. Some examples will include, using it in oil lamps and heaters, as lubricating oils and greases, as cutting oil in lathe machines or commercially converting it into biodiesel by alcoholysis that would not only improve our economy but also provide employment/entrepreneurial job opportunities. However, for commercial usage of used cooking oil it is important to develop an organised collection system from large users like food industry, hotels, etc., even homes, so that there is an uninterrupted supply of raw material for the biodiesel manufacturer to succeed in this sector. Any takers?