A study on knowledge, usage practice of reheated oil and comparison of oil degradation by repeatedly frying different types of food

[1]Syeda Nida Fatima, [2]Uzma Fatima

[1]Student, M. Sc, Nutrition and Dietetics

[2] Assistant Professor, Head, Department of Nutrition and Dietetics

St. Joseph's Degree and PG College for Women, Hyderabad, India
[1]nidasyeda328@gmail.com, [2]uzma.fatima91@gmail.com

Abstract **- The reuse of edible oils, especially in Indian households and commercial cooking, is a common practice that poses health risks due to physical and chemical changes from repeated heating. Sunflower oil, widely used for frying, can degrade and form harmful substances, yet many people continue to reuse it despite knowing the potential dangers. This study aimed to assess the degradation of sunflower oil reused for frying different foods by observing changes in colour, pH, and peroxide values. It also explored consumer oil usage habits and their awareness of the health risks linked to reused oils.**
An experimental and survey-based study was conducted using fresh sunflower oil and oil samples reused five times for frying non-masala snacks, vegetarian masala snacks, and non-vegetarian masala snacks. Colour, pH, and peroxide values were measured. A survey of 150 participants was also carried out to study oil usage practices and awareness. Peroxide values increased notably in oils reused for masala snacks, showing early signs of oxidation, though pH remained stable. Visual changes like darkening and cloudiness were more noticeable in reused oils. Survey findings showed that 61.3% of participants reused oil despite 86% knowing the health risks, indicating a gap between awareness and behaviour. The peroxide value increased from 0.04 to a maximum of 0.680 mEq/kg in the reused oil, suggesting early oxidation, while still staying under the ANVISA threshold of 10 mEq/kg. Although people are generally aware of the risks, oil reuse continues due to habits, cost-saving, and convenience. The study emphasizes the need for public education and simple guidelines to promote safer cooking practices and reduce health hazards.

Keywords **- Edible oils, Oil reuse, Peroxide value, Oil degradation, Consumer habits, Health risks, Sunflower oil.**

INTRODUCTION

Edible oils rank among the most fundamental components of diets worldwide, not just because of their cooking applications but also due to their nutritional value. These oils are derived from a variety of seeds and fruits such as soybean, sunflower, palm, mustard, rice bran, and olive, each offering a unique combination of fatty acids and micronutrients [1]. These oils differ significantly in their makeup and uses. Common varieties include sunflower oil, soybean oil, mustard oil, palm oil, corn oil, olive oil, rice bran oil, and canola oil [2].They are essential in cooking, particularly in frying, because they enhance heat distribution and contribute to the taste, aroma and texture of meals.. Common frying methods include stir-frying, sautéing, shallow frying, pan-frying, and deep-frying. In shallow frying and pan-frying, foods are partially immersed in oil and turned to ensure even cooking, necessitating oils that can endure moderate to high temperatures without degrading, such as light olive or peanut oil. Deep-frying, which involves complete submersion of food in oil at temperatures between 170–190°C, is a popular cooking method but should be approached with caution due to health hazards linked to the continuous use of oil and its oxidation[3].

The physical properties of oils serve as early indicators of quality degradation during multiple frying sessions. Elements like viscosity, density, specific gravity, color, and moisture content exhibit quantifiable changes. Fresh oil is generally light-coloured and has a low viscosity, but with repeated usage, it tends to darken, thicken, and form foam. These changes also indicate chemical instability. The rise in viscosity and density results from the build-up of polar compounds, polymers, and oxidized triglycerides. The development of foam often suggests the presence of moisture and breakdown products that act like surfactants. Assessing these properties is essential for determining if the oil remains safe and effective for continued use. Such changes should be regularly monitored during frying processes of foods like potatoes and fish that are exposed to high temperatures on multiple occasions, highlighting the importance of establishing early disposal guidelines for oil [4].

Reheating oils repeatedly initiates different chemical processes, such as oxidation, hydrolysis, and polymerization. Oxidation, whether thermal or auto-oxidation, results in the production of hydro peroxides, aldehydes, and ketones, which are both primary and secondary by-products of lipid oxidation. Additionally, hydrolysis produces free fatty acids that decrease the oil's smoke point and contribute to off-flavours. Polymerization, especially when oils are used at high temperatures for extended periods, results in the creation of triacylglycerol dimers and polymers. These substances not only raise viscosity but also pose potential health risks when consumed in large quantities [5].

Consistent reuse of frying oil contributes to the development and build-up of harmful substances, including trans-fats, malondialdehyde, acrolein, and polycyclic aromatic hydrocarbons. These substances have been linked to various negative health impacts such as elevated LDL cholesterol, oxidative stress, compromised endothelial function, and genetic mutations [6].

Public awareness regarding the health hazards of reusing cooking oil remains low in many regions. Despite the harmful effects of repeatedly heated oil such as the increased risk of heart disease, cancer, hypertension, and digestive problems many individuals continue to reuse oil without understanding its toxic impact. This lack of knowledge contributes to the continued use of reheated oils in households and food establishments, underscoring the urgent need for health education and public awareness initiatives [1].

METHODOLOGY

This study was an experimental and survey-based observational design, using purposive sampling of edible oil samples reused five times during cooking, and voluntary participants for the questionnaire. The sample included fresh oil and reused oil samples: one used five times to fry non-masala snacks, one for vegetarian masala snacks and one for non-vegetarian masala snacks. A total of 150 individuals using cooking oil for domestic purposes and willing to participate were included, while those unwilling or not using oil were excluded. Oil analysis was done using the Peroxide Value Test to assess the level of oxidation in the samples.

STATISTICAL ANALYSIS

The arithmetic mean was used to determine the average of the collected data, while standard deviation measured the degree of variation or dispersion from that average. A t-test was performed to evaluate if the disparity between the averages of two groups was statistically significant. The p-value was useful in determining the importance of the results that were observed.

RESULT AND DISCUSSION

PHYSICAL PROPERTIES (COLOUR)

Fresh oil appeared clear and bright, while oil reused for non-masala snacks showed minimal change. Slight darkening occurred with vegetarian masala snacks, and significant darkening and turbidity were observed with non-vegetarian masala snacks, indicating progressive physical degradation due to spices and meat content.

Type of oil	Re-usage Frequency	Foods Cooked	Peroxide Value mEq/Lt
Sunflower oil (Fresh)	-	None	0.04
Sunflower oil (Reused)	5 Times	Non Masala snack	0.092
Sunflower oil (Reused)	5 Times	Veg Masala snack	0.652
Sunflower oil (Reused)	5 Times	Non-Veg Masala snack	0.68

THE ACIDITY

The pH testing showed no significant change between fresh and reused oil samples, even after five uses across all food types. This indicates minimal chemical alteration despite repeated heating and spice exposure.

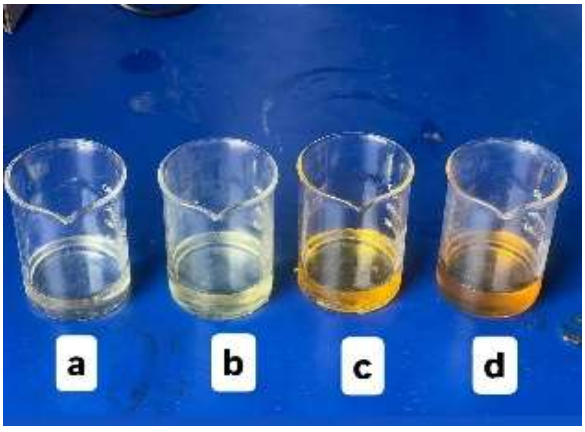

Fig:1: Visible changes in oil colour of samples

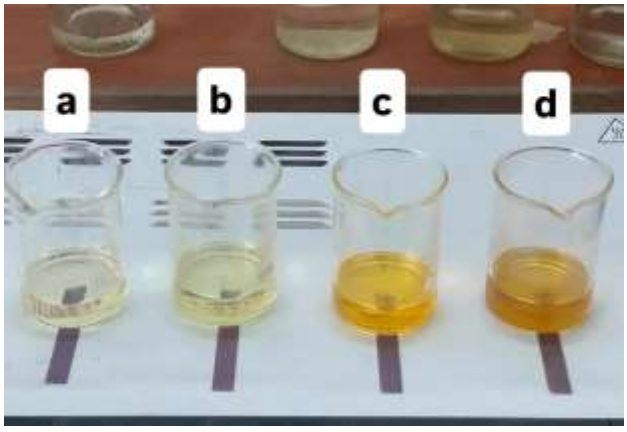

Fig:2: pH evaluation of oil samples

a. Fresh oil sample b. 5 times used non masala snack c. 5 times used veg masala snack d. 5 times used non-veg masala snack

Table 1: Peroxide value of sunflower oil with different reuse frequencies and food types

Peroxide value analysis showed a sharp increase in oxidation with reuse. Fresh sunflower oil had a peroxide value of 0.04 mEq/kg, which rose to 0.092 for non-masala snacks, 0.652 for vegetarian masala snacks, and 0.680 for non-vegetarian masala snacks. Though

still below the ANVISA limit of 10 mEq/kg, these values reflect early-stage oxidative degradation due to repeated heating and the type of food cooked. [7]

Table 2: T-test results comparing oil reuse behaviour and health awareness

	Yes	No	Mean	SD ±	P value
Oil reuse practice	92(61.3%)	58(38.7%)	1.61	0.49	0.415
Oil reuse knowledge	129(86%)	21(14%)	1.86	0.35	

P > 0.05 is not significant between knowledge and practice

T-test results comparing oil reuse behaviour and health awareness showed that 86% of participants were aware of the health risks, but 61.3% still reused oil. The higher mean score for awareness (1.86) compared to practice (1.61) indicated a gap between knowledge and behaviour. The p-value (0.415) showed no significant difference, aligning with other studies that found knowledge does not always translate into safer practices. This underscores the need for targeted education and behavioural change strategies. [8]

The study of 150 respondents found most were young, female, non-vegetarian housewives or students. Sunflower oil was commonly used, with over half consuming more than one litre monthly. The survey revealed common practices such as reusing oil for frying, occasional filtering, and basic storage in sealed containers. Despite 86% of participants being aware of the health risks, such as heart disease and cancer, over 60% admitted to reusing oil. Cultural habits, cost-saving needs, and convenience were the major reasons for continued reuse. The study identified a gap between awareness and behaviour, suggesting that informed individuals do not necessarily adopt safer practices.

CONCLUSION

The study concludes that while public awareness of the harmful effects of reheating oil is relatively high, it does not translate into consistent or safe usage behaviours. Cultural norms, economic constraints, and routine cooking practices continue to encourage repeated oil use. Therefore, awareness alone is insufficient to drive behavioural change. The findings underline the importance of promoting practical and accessible alternatives such as using smaller quantities of fresh oil, adopting oil-free cooking methods like air frying, and selecting oils with better heat stability. The development of household guidelines including safe frying limits and visual cues for oil disposal could support informed decision-making. A combined approach involving public education, behavioural nudges, and policy support is essential to reduce health risks and encourage safer oil handling practices at the domestic level.

REFERENCES

[1] Perumalla Venkata, R., & Subramanyam, R. (2016). Evaluation of the deleterious health effects of consumption of repeatedly heated vegetable oil. Toxicology Reports, Volume 3, pages 636–643.
[2] Nawaz, H., Shad, M. A., Hassan, S., Shah, M., Shahzad, H., Jabeen, R., Nawaz, A., Riaz, Z., & Jamal, S. (2019). Comparative Evaluation of Physical and Physicochemical Properties and Antioxidant Potential of Various Cooking Oils. European Journal of Nutrition & Food Safety, 10(3), 199-207.
[3] https://www.who.int/
[4] Jurid, L.S., Zubairi, S.I., Kasim, Z.M., & Kadir, I.A.A. (2020). The effect of repetitive frying on physicochemical properties of refined, bleached and deodorized Malaysian tenera palm olein during deep-fat frying. *Arabian Journal of Chemistry*, 13, 6149–6160. Volume 13, pages 6149–6160.
[5] Mishra, S., Firdaus, M. A., Patel, M., & Pandey, G. (2023). A study on the effect of repeated heating on the physicochemical and antioxidant properties of cooking oils used by fried food vendors of Lucknow city. Discover Food, 3:7. Volume 3, page 7.
[6] Szabo, Z.; Marosvölgyi, T.; Szabo, E.; Koczka, V.; Verzar, Z.; Figler, M.; Decsi, T (2022). Effects of Repeated Heating on Fatty Acid Composition of Plant-Based Cooking Oils. Foods 2022, 11, 192. Volume 11, article number 192.
[7] Jesus, D. J. F., & Gomes, D. C. (2019). Comparative analysis of rancidity development in vegetable oils during frying process. Journal of Advances in Pharmacy and Healthcare Applications, Volume 6, pages 65–74.
[8] Zainah M., Norsuriani Azni MY, Nurul Izzati S, Prasant P, Loshiny DJ, Imran Nabil AAA (2023). Usage of Repeatedly Heated Cooking Oil and Its Relationship to Knowledge and Practice among Nurses. Med & Health Jun 2023; Vol :18(1): 195-210.