

Assessment of Deterioration Quality of Different Brands of Groundnut Cooking Oil Sold in Market Before and After Frying

Dr. Shashikant Pardeshi*

Food Analyst, DPHL, Jalgaon, Maharashtra, India

ABSTRACT: Frying leads to oil decomposition. The nature, rate, and products of decomposition are influenced by the composition of the oil such as fatty acids pattern, unsaponifiable matter content, physicochemical characteristics, the mode of frying which are continuous and deep-frying, applied frying temperature, the length of the frying process, and type of food being fried.

Vegetable oils are triglycerides extracted from plants. Edible vegetable oils are used in food, both in cooking and as supplements. There are three types of vegetable oils (before and after frying) were analysed using standard procedures of (AOAC) and (AOCS), the physicochemical properties Acid, peroxide, Iodine, SV and EV values were investigated. The results of obtained were ranges between 2.69-5.39(± 0.45) in fresh oils and 6.47-9.93(± 0.33) mg KOH/g oil in after frying oils, 9.5-13.6(± 0.41) in fresh oils and 9.5-13.6(± 0.32) Meq/Kg in after frying oil, 91.24-92.4(± 0.39) in fresh oils and 85.86-87.48g(± 0.36) I₂/100g in after frying oils, 191.28-193.46(± 0.36) in before frying oil and 198.28-203.36(± 0.31) g/KOH/g in after frying oils, 186.8-190.13(± 0.21) in fresh oils and 189.98-196.89(± 0.35) g/KOH/g in after frying oils respectively of AV, PV, IV, SV and EV with respective oils used in this research work. Furthermore, There is no change PV in after frying. Acid and Peroxide values in frying oils were to exceeded the permitted value of 5mg/KOH g, 10 meq/kg. IV are decreases in after frying as compared with in before frying oils. The standard mean errors are in the range of ± 0.12 - ± 0.26 before and after frying.

KEYWORDS: Groundnut oil, frying, Acid, Iodine, Peroxide, SV, EV

I. INTRODUCTION

Since ancient times, plant, and animal products are cooked, baked, roasted, or fried, to make them more palatable and to improve their digestibility. The heat can be transferred from air, water, or oil to the product. Frying as a cooking method started probably around the 6th Century BC. It is the process of using oil as the cooking medium (Gertz et al. 2014)[1]. The range of temperatures used for frying is 150 – 200 °C. Heat transfer during frying can be by conduction, convection, or both[2]. Fried oil relies on changes in the stability of the taste or quality of the oil by hydrolysis, oxidation, and polymerization. Tocopherols, essential amino acids, and fatty acids in the diet degraded during frying. Changes frying oil depends on factors like the freshness of the oil, frying conditions, the original quality of cooking oil, fried foods, types of frying, antioxidants, oxygen concentration. Frying temperature is high, the amount of fried oil, free fatty acids, polyvalent metal, and unsaturated fatty acids decrease the stability of the oil due to oxidation and the taste quality of the oil. Frying oil with high temperatures can degrade the effectiveness of antioxidants.[3-4]

The peroxide value is used to determine the level of oil damage. The peroxide value standard for vegetable oils that do not undergo rancidity should be well below 10 meq/kg. The value of free fatty acid is often used as an indication of the general condition and the nature of the oil is safe to eat.[5] Saponification value is a rough index of the molecular weight of the fat or oil. The smaller the saponification value higher molecular weight. It also shows the magnitude of the amount of alkali required to convert the amount of fat or oil to be soap. It can be used for checking the purity of fats or oils.

II. RELATED WORK

Edible oils are derived from a wide variety of plants and plant seeds and are used in many aspects of domestic and world-wide food production. Once the oil has been extracted from a plant seed, it is refined as needed for use in foods such as salad dressings, margarine, shortenings, snack foods and frying oil. Edible oils are extracted and processed world-wide and hence are important domestic and international commodities. Edible oils are very important food for world. The human body uses oils and fats in the diet for three purposes, as an energy source, as a structural component and to make powerful biological regulators. Oils and fats also play an important role in

metabolic reactions in the human body. Oils and fats contain fatty acids, which are susceptible to attack by a number of agents e.g. light, oxygen, metals, etc [6-8].

Edible oils from plant, animal, or synthetic origin, are used in frying, baking, and other forms of cooking, and in salad dressings and bread dips. Plant-derived edible oils consist of carboxylic acids with long hydrocarbon chains, in contrast to petroleum-based oils which lack the carboxyl group on the end. The carboxyl group makes the oils edible, providing a site for human enzymes to attack and break down the chain in a process called beta-oxidation. There are a wide variety of cooking oils from plant sources such as olive oil, palm oil, soybean oil, canola oil (rapeseed oil), corn oil, peanut oil and other vegetable oils, as well as animal-based oils like butter and lard. This paper incorporates a comparative study of different types of frying oils by their physicochemical properties and compositional qualities. There are numerous health benefits of frying oils which has been covered in the paper along with the future of edible oils in India[9].

Che et al (2000) stated and observed that deep frying is one of the most common methods used for the preparation of food. Repeated frying causes several oxidative and thermal reactions which results in change in the physicochemical, nutritional and sensory properties of the oil (Che Man and Jasvir, 2000)[10]. During frying, due to hydrolysis, oxidation and polymerization processes the composition of oil changes which in turn changes the flavor and stability of its compounds (Gloria and Aguilera, 1998)[11]. During deep frying different reactions depend on some factors such as replenishment of fresh oil, frying condition, original quality of frying oil and decrease in their oxidative stability[12].

Fats and oils are parts of normal daily consumptions. As a major source of energy, fats and oils are considered as important nutrients in human diets. The edible oils are used in cooking as well as in traditional medicine for the treatment of colds, coughs, bronchitis, edema and burns, also play an important role in the body as carriers of essential fatty acids which are not synthesised in the body but are needed through the diet to maintain the integrity of cell membranes. They are also needed for the synthesis of prostaglandins which have many vital functions to perform in the body. Vegetable oils are beneficial and popular due to their cholesterol-lowering effect. In contrast to animal fats, which are predominantly saturated and hence do not react readily with other chemicals, especially oxygen, unsaturated vegetable oils are more reactive. Vegetable oils are essential in global nutrition depending on the regional conditions, a variety of oils are produced in different qualities [13-14].

The conventional standard analytical methods (SAM) used to determine both primary and secondary oxidation products that rely on the use of organic solvents. It includes iodometric titration procedures used to determine hydroperoxides (PV), degree of unsaturation (IV); ferrous oxidation method for peroxides; alkali based titration used for determination of free fatty acids (FFA); derivatization into methyl or silyl esters respectively before other analyses that follow [15-17]. These SAM have been used over the years as effective quality control and analytical tools to monitor frying fats and oils. While some are easy to determine by titration, others are laborious and involve large amounts of organic solvents and effluents[18]. The analytical techniques requiring for direct determination such as ultraviolet-visible (UV-VIS) Spectroscopy and Chromatography. They are used to measure complex mixtures of lipid oxidation molecules of aldehydes, ketones, epoxides, hydroxyl compounds, oligomers, and polymers[19].

Several factors affect the edible oil quality such as agronomic techniques, seasonal conditions, sanitary state of drupes, ripening stage, harvesting and carriage systems, method and duration of storage, and processing technology. The major factors affecting edible oil quality are temperature, moisture, sunlight, soil fertility, and nutrients. It is possible to determine by different analytical techniques how to assess the quality of edible oil and to avoid possible adulterations [20].

The aim of present study was to evaluate the effect of frying on the chemical properties such as acid value (AV), iodine value (IV), peroxide value (PV), SV and EV of different brands of Groundnut edible cooking oils were measured before and after frying and to assess whether these oils could be re-used or not.

III. METHODOLOGY

All the chemicals reagents and glassware used in this analytical work are analytical grade. Edible oil samples Filtered groundnut oil(Tirupati)(Fgn), Filtered groundnut oil(Ankur)(Fgn1), Filtered groundnut oil(Kanak)(Fgn2), Filtered groundnut oil(Dhara)(Fgn3), Filtered groundnut oil(Dammani)(Fgn4), Filtered groundnut oil(Fortunr)(Fgn5), Filtered

groundnut oil(Gemini)(Fgn6), Filtered groundnut oil(Rani)(fgn7), Filtered groundnut oil(postlite)(Fgn8),Pure groundnut oil(Pgn) oils were purchased from some food super markets in Jalgaon city of Maharashtra, India and home kitchen uses. In this study, cooking oil samples of different types of oil were subjected to controlled heating and frying in the laboratory. The acid value, peroxide value, ester value and saponification value of edible oil before and after frying were measured according to the AOCS and AOAC [21-31]. All reagents are of analytical grade unless otherwise stated. Deionized water was used for preparation and dilutions of standard solutions. Nitric acid (HNO₃) and sulfuric acid (H₂SO₄) reagents were used for cleaning of glassware and for digestion of the samples. Representative edible oil samples were used for analysis. Chloroform, potassium iodide (KI), glacial acetic acid, and sodium thiosulphate were used for estimation of peroxide value. Hydrochloric acid (HCl), sodium hydroxide (NaOH), ethanol, and phenolphthalein indicators were used for estimation of acid value and saponification value, respectively; carbon tetra chloride, potassium iodide, and Wijs reagent were used for estimation of iodine value.

Determination of Chemical properties [22-31]

Determination of Acid Value of the Oil

Acid value was measured by titration with sodium hydroxide according to the American Oil Chemists' Society (AOCS) method Cd 8-53 (AOCS, 1989b).

Saponification value: The saponification value (SV) of the sample was obtained by following IS 548 method (IS 548, 2015b).

Method for determination of ester value

The ester value is the 'mg' of KOH required to react with glycerol/ glycerin after saponify 1 g of oil sample. Ester value is calculated by the following relation

$$\text{Ester Value} = \text{Saponification Value} - \text{Acid Value}$$

Iodine value: The iodine value (IV) of the sample was measured using IS 548 (IS 548, 2015c).

Peroxide value: The acetic acid-chloroform method of the AOCS (Method Ca 5a-40) was used for determination of the peroxide value (PV) (AOCS, 1989c).

IV. EXPERIMENTAL RESULTS

Experimental results of different brands of Groundnut oils before and after frying

Table 1. Chemical characteristics of Groundnut oil before and after frying.

Sr. no	code of oil	Before frying					After frying				
		AV, mg KOH / g oil	PV, Meq/ Kg	IV	SV, mg KOH / g oil	EV, mg KOH /g oil	AV, mg KOH / g oil	PV, Meq/K g	IV	SV, mg KOH / g oil	EV, mg KOH /g oil
1	Fgn	4.48	10.0	91.68	191.28	186.8	8.30	10.0	86.28	198.28	189.98
2	Fgn1	3.77	12.36	92.40	192.14	188.37	7.85	12.36	87.48	199.46	191.61
3	Fgn2	4.31	13.6	91.58	191.68	187.37	8.63	13.6	85.92	200.12	191.49
4	Fgn3	5.39	12.7	91.24	192.48	187.09	9.71	12.7	86.24	201.26	191.55
5	Fgn4	4.26	9.5	93.82	193.46	189.2	8.30	9.5	87.82	200.32	192.02
6	Fgn5	2.69	12.1	92.38	192.82	190.13	6.47	12.1	86.84	203.36	196.89
7	Fgn6	3.26	10.0	91.56	192.78	189.52	7.85	10.0	85.86	201.68	193.83
8	Fgn7	3.02	9.0	92.18	191.98	188.96	8.30	9.0	86.38	202.64	194.34
9	Fgn8	5.38	13.5	91.68	192.35	186.97	9.93	13.5	85.46	200.46	190.53
10	Pgn	3.77	9,9	92.12	191.84	188.07	8.97	9,9	85.88	201.84	192.87
11	Total	40.33	102.76	920.64	1922.81	1882.48	84.31	102.76	864.16	2009.42	1925.11
12	Mean	4.4811	11.42	102.29	213.66	209.16	9.37	11.42	96.02	223.27	213.90
13	SD	0.45	0.39	0.41	0.36	0.21	0.33	0.36	0.32	0.31	0.35
14	CV	9.97	3.44	0.4	0.17	0.1	3.47	3.11	0.33	0.14	0.16
15	SEM	0.26	0.23	0.24	0.21	0.12	0.19	0.21	0.19	0.18	0.2

(*AV-acid value, IV-Iodine value, PV-peroxide value, SV-Saponification value, EV-Ester value, SD-standard deviation, CV-coefficient of variation, SEM standard error)



Table 2. Test results of frying oils and codex standard

Sr.no	Test	Before frying	After frying	Codex Alimentarius commission standard
1	Acid value mg KOHg-1	2.69-5.39	6.47-9.93	0.6
2	IV gI2/100g	91.24-92.4	85.86-87.48	--
3	Peroxide value Meq O2/kg	9.5-13.6	9.5-13.6	10.00
4	Saponification value mg KOHg-1	191.28-193.46	198.28-203.36	---
5	Ester value mg KOHg-1	186.8-190.13	189.98-196.89	---

Statistical Analysis:

The data obtained from the experimental measurements and accuracy of different parameters for different varieties of oils have been analysed and the Statistical parameter like standard deviation, coefficient of variance and standard mean error were calculated for AV,IV,SV and EV for different brands of oils before and after frying. All the experiment was carried out in triplicate and the results are presented as the mean ± SD, CV, ± SEM. Accuracy and descriptive Statistics of different oils from different parts of India as shown in figure1to3.

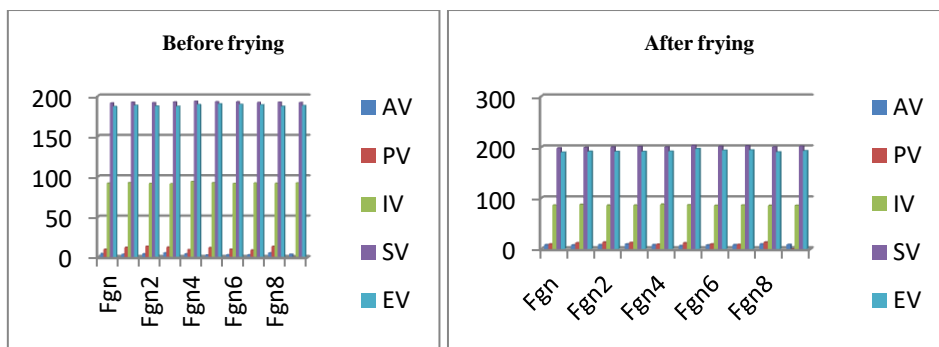


Figure 1-2. Plot of different characteristics of different groundnut edible vegetable against the obtained experimental data before and after frying

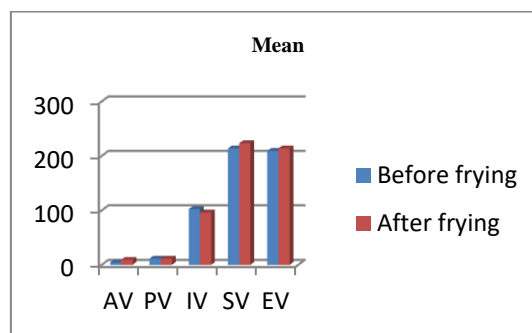


Figure 3. Accuracy and descriptive Statistics of different brands of groundnut edible vegetable oils from different parts of India.

V. RESULT AND DISCUSSION

Chemical characteristics of different brands of groundnut oils before frying and after frying have been extensively investigated. The experimental results of AV, PV, IV, SV and ester values were illustrated in Tables 1-2 and figures 1-3. It can be seen from the tables and figure that, the acid value of groundnut oil are in the range of 2.69-9.93($\pm 0.45-0.33$) in before and after frying, had higher value compared with that before frying. Generally, the increase of the acid value of the investigated samples may attribute to the complete inhibition of enzymes activity. In case of Iodine value, it is in between the range of 91.24-87.48 ($\pm 0.39-0.36$) which is lower in after frying which are gradually decreased as the result of destruction of double bonds in after frying, the result was not in this expectation. The obtained results of PV in the range of 9.5-13.6($\pm 0.41-0.32$) which are not changes in after frying. It is clear from the obtained results (Tables 1, 2 and Figure 1-3) that, SV and Ester value in the range of 191.28-203.36($\pm 0.36-0.031$) and 186.8-196.89($\pm 0.21-0.35$) which are higher than food safety limit. These results might be due to the effect of high frying temperature causing destruction of some glycerides. It can be noticed that, after frying, AV, PV, SV and Ester values were found higher and Iodine values are lower than as compared with safety limit. The results showed degradation in the physico-chemical properties of the vegetable cooking oil after frying.

A.V. measures the content of free fatty acids formed upon the hydrolytic degradation of lipid molecules, thus contributing the reduction of shelf life of oil. According to Codex Alimentarius Commission standard acid value up to 5 mg KOH/gm of oil is safe for consumption. Here the acid value (table 1) in before and after frying is above 5 mg KOH/gm of oil so it is unsafe for human consumption. P.V. defines the content of lipid hydroxides in oil formed under conditions of auto and photo-oxidation. The oil shows after frying the higher P.V. (table 1) which are exceed the recommended limit of P.V. of oil (10 mequ O₂/Kg oil.)

VI. CONCLUSION

The different brands of edible sunflower oils of home kitchen use as samples before and after frying are investigated the oxidative status, In this study, It is clear from the obtained results that, the AV, PV, SV and EV of edible oil are gradually increased after frying compared with that before frying and Iodine value decreases as compared with before frying. Higher AV and PV which indicates the extent of secondary oxidation occurred in oil sample, indicating that it might be due to the effect of high frying temperature causing destruction of some glycerides. The use of same oil for frying many times is a general practice mostly in commercial and sometimes in domestic cooking processes. This practice generates lipid per oxidation products that may be harmful to human health.

REFERENCES

- [1].Gertz C, Aladedunye F & Matthäus B Deep-fat frying – An ancient popular process with a lot of open questions. *European Journal of Lipid Science and Technology*. 116(6), 667-668,2014.
- [2].Moreira RG, Vacuum frying versus conventional frying – An overview*. *European Journal of Lipid Science and Technology*. 116(6), 723-734,2014.
- [3].Syafruddin Ilyas ,Peroxides and Saponification Value to Some Packaging of Palm Oil after Frying Repeatedly , *International Journal of PharmTech Research*, ISSN: 0974-4304, 9(12): 560-564,2016.
- [4].Adel et al, Adel Imhemed Alajtal, Fatima Emhemed Sherami, Mohamed Atiga Elbagermi. Acid, Peroxide, Ester and Saponification Values for Some Vegetable Oils Before and After Frying. *AASCIT Journal of Materials*. Vol. 4(2): 43-47,2018.
- [5]. Bereket Tesfaye and Alemayehu Abebaw, Physico-Chemical Characteristics and Level of Some Selected Metal in Edible Oils *Hindawi Publishing Corporation Advances in Chemistry* ,Volume 2016, Article ID 3480329, pp1-7,2016.
- [6]. Choe E, Min DB. Chemistry of deep-fat frying oils. *Journal of Food Science*, 72(5) R (77-88), doi:10.1111/j.1750-3841.2007.00352.x,2007.
- [7].Bou et al, Quality assessment of frying fats and fried snacks during continuous deep fat frying at different large scale producers food control 27(1),254-267,2012..
- [8]. Naghshineh and Mirhosseini ,Effects of frying condition on physic-chemical properties of palm-olein-olive oil blends ,*journal of agriculture and environment* 8(3-4),175-178,2000.
- [9].Kakali Bandyopadhyay, Chaitali Chakraborty, Suravi Chakraborty and Shairee Ganguly, Change in physicochemical properties of edible oil during frying: A review, *The Pharma Innovation Journal* , 6(10): 196-199,2017.
- [10].Che Man, Y.B., Jasvir, I., Effect of rosemary and sage extracts on frying performance of refined, bleached and deodorized (RBD) palm olein during deep fat frying. *Food Chem*. 69, 301–307,2000..

- [11].Gloria, H., Aguilera, J.M., Assessment of the quality of heated oils by differential scanning calorimetry. *J. Agric. Food Chem.* 46, 1363–1368,1998..
- [12].Choe, E., Min, D.B., Chemistry of deep-fat frying oils. *J. Food Sci.* 72, 77–86,2007..
- [13].Setiowaty et al, Quantitative determination of peroxide value in thermally oxidized palm olein by fourier transform infrared spectroscopy phytochemical analysis,11(2),74-78,2000.
- [14].Weisshaar, Quality control of used deep-frying oil, *European journal of lipid science andTecnology*, 116(6), 716-722,2014.
- [15].Dumont M-J & Narine SS, Soapstock and deodorizer distillates from North American vegetable oils: Review on their characterization, extraction and utilization. *Food Research International.* 40(8), 957-974,2007.
- [16].Nuchi C, Guardiola F, Bou R, Bondioli P, Della Bella L & Codony R Assessment of the Levels of Degradation in Fat Co- and By-products for Feed Uses and Their Relationships with Some Lipid Composition Parameters. *Journal of Agricultural and Food Chemistry.* 57(5), 1952-1959,2009.
- [17].Barriuso B, Astiasarán I & Ansorena D , A review of analytical methods measuring lipid oxidation status in foods: a challenging task. *European Food Research and Technology.* 236(1), 1-15,2013.
- [18].Weisshaar R (2014) Quality control of used deep-frying oils. *European Journal of Lipid Science and Technology.* 116(6), 716-722.
- [19].Márquez-Ruiz G, Holgado F, García-Martínez MC & Dobarganes MC, A direct and fast method to monitor lipid oxidation progress in model fatty acid methyl esters by high-performance size-exclusion chromatography. *Journal of Chromatography A.* 1165(1–2), 122-127,2007.
- [20]. R.Manorama and C. Rukmini, “Nutritional evaluation of crude palm oil,” *The Oil Technologists’ Association of India*, vol. 22, pp. 83–87, 1991.
- [22].AOCS, Official Method Cd 8-53: Peroxide Value Acetic Acid-Chloroform Method. *American Oil Chemists Society Sampling and Analysis of Commercial Fats and oils* (1997b).
- [23] ISI Hand book of food Analysis (part III) 1984 page 67/ IUPAC2.201 (1979) I.S, 548 (Part-1)-1964 method of sampling and test for oils and fats/ISO 6601 1996 Determination of acidvalue and acidity.
- [24] A.O.A.C, OfficialMethod 920.160-Saponification Number of Oils and Fats/IUPAC 2.202 I.S.I Hand Book of Food Analysis (Part XIII 1984), A.O.A.C, 17th edition, 2000.
- [25] A.O.A.C, Official Method 920.159-Iodine Absorption Number of Oils and Fats/I.S.I Hand Book of Food Analysis Part-III-1984, A.O.A.C, 17th edition, 2000.
- [26].Firestone D, Official methods and recommended practices of the AOCS 6th ed. *American Oil Chemists' Society*,2009
- [27].AOAC. (1990), Official Methods of Analysis, Association of Official Analytical Chemists. Washington, DC.
- [28]. A.O.A.C, Official Method 965.33 Peroxide value in oils and fats/Pearson’s composition and analysis of food, 17th edition, pp. 641, 2000.
- [29].DGHS,(2012)., Directorate General of Health Services, Manual of Methods of Analysis of Foods Oils and Fats), Food Safety standards authority of India (FSSAI), Ministry of Health and Family Welfare, Government of India, New Delhi.
- [30] IS 548 (Part I). Determination of saponification value. Method. No.15: pp 50,2015b.
- [31]IS 548 (Part I)., Determination of iodine value. Method. No.14: pp 47,2015c.