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Comparative Studies on Deterioration Quality of Frying Oils used in Commercial Restaurants in Jalgaon City of Maharashtra, India

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ABSTRACT

Deep fat frying can lead to deterioration of physical, chemical, nutritional and sensory properties of oil, which affects its frying performance. It also results in the production of volatile products such as aldehydes and non volatile fraction which remains in the frying medium. Some of these remaining products have been implicated in producing adverse health effects. Highly oxidized oils may also produce polyaromatic hydrocarbons, which have carcinogenic effect. The repeatedly frying oil samples were collected from the restaurants and fast-food outlets of various types of from municipality areas of Jalgaon city and daily used oils for frying in municipality areas of Jalgaon city in amber bottles for analysis and used to evaluate the quality of these oils using standard producers. In this study, The physiochemical parameters such as Moisture, density, viscosity, AV, IV, PV, P-anisidine value, totox values and TPM were used to monitor deterioration of fried oil while it was used to authenticate oil samples. In this study, the results showed that in the range of 0.05-0.34(±0.17), 0.9188-0.9277(±0.35), 33.78-44.48 (±0.03), 0.56-4.31(±0.53), 80.88-115.87(±0.16), 8.78-13.56 (±0.87), 9.56-14.18 (±0.69), 29.28-41.3(±0.38) and 10.24-20.0 (±0.26) respectively. The AV, PV and totox values which were significantly higher compared to the Codex Alimentarius Commission standards. Peroxide values of 8.78-13.56 ± 2.179 meq O2/kg deviated from the Codex standard value of 10 meq O2/kg. Acid values of 0.56-4.315±0.605 mg KOH/g, which were significantly higher compared to the Codex Alimentarius Commission standards. In general, it was seen that, fast-food origin waste frying oils' viscosities, water contents and AVs were higher and iodine values were lower than those from other sectors. The densities of all the samples were generally close to each other. The results showed degradation in the physico-chemical properties of the vegetable cooking oil after repetitive frying. The awareness of the general public in India regarding the usage of repeatedly heated cooking oil needs to be increased. More publicity and exposure about this little-known health issue should be given in the mass media.

KEYWORDS: *Repeated frying oils, Moisture, AV, IV, SV, PV, P-anisidine value, Totox value, human health problem*

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1. INTRODUCTION

Fat frying is one of the oldest and popular food preparations. Fried foods have desirable flavour, colour and crispy texture, which make deep-fat fried foods very popular to consumers. Frying is a process of immersing food in hot oil with a contact among oil, air, and food at a high temperature of 150 to 190°C. The simultaneous heat and mass transfer of oil, food and air during fat frying produces the desirable and unique quality of fried foods. Frying oil acts as a heat transfer medium and contributes to the texture and flavour of fried food[1]. Numerous types of edible oils of plant and animal origin are used in frying, depending on regional availability. Palm oil is often used in Southeast Asia, coconut and groundnut oil in the Indian subcontinent, and olive oil in the Mediterranean region. During the last five decades, the Western food industry has become increasingly dependent on the frying process to manufacture a variety of snack foods. Fried foods such as potato chips, french fries, and fried fish and chicken have gained worldwide popularity[2].

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[3]. 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 [4]. 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[5]. Atmospheric oxygen reacts instantly with lipidand other organic compounds of the oil to cause structural degradation in the oil which leads to loss of quality of food and is harmful to human health [6]. Therefore, it is essential to monitor the quality of oil to avoid the use of abused oil due to the health consequences of consuming foods fried in degraded oil, to maintain the quality of fried foods and to minimize the production costs associated with early disposal of the frying medium [7].

During frying oprations,temperature which should be in the range of 160 - 180°C for frying operations[8]. Aladedunye and Przybylski stated and concluded that the highest temperatures were observed for vegetable cooking fat (173.6°C) while the lowest temperatures were examined for using vegetable shortening oil (124.1°C) [9].Soriano mentioned and recommended that the extent of oxidative deterioration, as measured by the TPM formation, was faster during frying at 215°C compared to 185°C. the continuous heating as the intermittent heating is much deleterious due to an increased rate of oil breakdown[8].

During frying process, oil is continuously or repeatedly subjected to high temperatures in the presence of air and moisture. Three essential degradation reactions occurs under these conditions are Hydrolysis causing from the moisture content of fried food. This reaction produces free fatty acids (FFA), mono- and diglycerides. Oxidation causing from the contact with oxygen. Reaction products are oxidized momomeric, dimeric and oligomeric triglycerides and volatile materials such as aldehydes and ketones. Polymerization causing from these two reactions, and high temperatures. This reaction produces dimeric and polymeric triglycerides with ring structure. Because of these degradation reactions mentioned above, a number of physical and chemical changes occur in frying oils including increase in viscosity, density, FFA content, total polar material (TPM), polymerized triglycerides, and decrease in smoke point, the number of double bonds, etc. If the frying process is continued, these materials will undergo further degradation and finally the oil will not be appropriate for frying. The frying oil has to be discarded [10-11].

Frying oils used continuously or repeatedly at high temperatures in the presence of oxygen from the air and water from the food being fried are subjected to a series of degradation reactions, producing a variety of decomposition compounds. Methods of chemical analysis of these decomposition compounds in deep frying oils are reliable [12]. Among the chemical methods, the measurement of total polar compounds (TPC) in frying oils is the most reliable and common method used [13]. The determination of carbonyl compounds (known as carbonyl value, CV) in frying oils is a very important chemical method for evaluating the quality of frying oils, because these compounds often contribute to rancid and unpleasant flavours, and reduce the nutritional value of fried foods [14].

The thermo stability of frying oils during deep fat frying is most desirable. This depends on factors such as the type of oil and its composition, the frying procedure and the type of food being fried [15]. Other conditions that affect the rate of thermal degradation of oils include the presence of pro-oxidants (such as water, oxygen, salt, iron and cupper) and anti-oxidants (natural and synthetic)[16]. The mechanism of thermal oxidation mainly comes from free radical mediated breakages of the unsaturated sites of the triacylglycerols (TAG)[17-18]. Oil degradation reactions that occur during deep-fat frying are hydrolysis, oxidation, isomerization, and polymerization [19]. Frying oil degradation results in the generation of free fatty acids, small molecular weight alcohols aldehydes, ketone, lactone, and hydrocarbons [18]. Other compounds that have been identified in degraded oils include polymerized diacylglycerols, monoacylglycerols, oligomeric, cyclic, and epoxy compounds [20] as well as *trans*-fats and volatile short-chain aldehyde compounds such as acrolein[21]. Some of these degradation products affect the quality of the fried products and can potentially harm the consumers' health [22]. It is necessary that any frying oil be reasonably stable to thermoxidation during extended exposure to the high temperatures (150 – 190 ^{0}C) used in frying different kinds of foods. Chemical indicators such as the free fatty acid (FFA), peroxide value (PV), *para*-anisidine value (*p*-AV), and total polar compounds (TPC) are used in monitoring frying fats and oils. The TPC and polymeric triacylglycerols are among the most reliable frying oil degradation indicators used in regulations by many countries [22-23].

1.1. Literature Review

The increasing use of edible oils and fats for the preparation of fried products requires an strict control in order to maintain the quality and safety of the fried foods. Due to the knowledge that the frying process alters the chemical nature of the heated oil and its consumption represents health risks,[24-25]. studies on the assessment of the quality of frying oils, which studies are used by the industry of fried products of immediate consumption, have shown the need for measures to reduce the degree of degradation of oils and fats. In this sense, by seeing that it is a public health problem, many countries have adopted regulations, recommendations and legal standards in order to protect consumers by limiting the use of frying oils and fats for human consumption [26-27].

In their studies, several authors have sought to identify the compounds formed in the frying oil and the biological importance. Among these publications there is an agreement with respect to the new compounds which are formed. The importance of the volatile compounds, partially eliminated during frying, is closely related to the sensory characteristics of oil and fried products,causing deterioration of flavor, aroma and visual appearance, besides the formation of potentially toxic polymeric compounds[28-29].

Moisture in foods induces and accelerates oxidation with the hydrolytic compounds. Foods with high water content like potato and foods with breading or battering materials cause faster hydrolysis of frying oil. During frying, the fat of chicken or pork that is released into frying oil alters the fatty acid composition and increases the degradation rate of the oil[30]. The release of amino acids from food into oil can prevent oil degradation during deep frying, but the starch has not been observed to have a similar effect[31]. However, only very few researches related to the influences of oil and food types on frying oil quality can be found.

Specific gravity is determined and calculated at temperature 20°C as a ratio of mass in air of a given volume of the oil or fat to that of the same volume of at 20°C. It can reveal the extent of adulteration and may be used as a means of acceptance of oils as raw materials as well as determination of size of pumps and piping in plant installation. The relative density of most oil range between 0.89 and 0.92 at 20°C[34]. Other variable properties of oil include solubility, freezing point, colour, odour and boiling point. Oil spoilage can be prevented through exclusion of air, addition of antioxidants, addition of chelation agents and hydrogenation[33-34].

Free fatty acid value is often used as general indication of the condition and edibility of oils .Iodine value is a measure of the degree of unsaturation or double bonds among the fatty acid present in the oil therefore it does not tell precisely the fatty acids composition of any oil. Iodine value or number is useful as a guide to check adulteration of oil and also as a process control of oil. Peroxide value is used in determining the degree of spoilage. The standard peroxide value for edible oils which have not undergone rancidity must be well below 10 meq/kg[33].

Peroxide value is a measure of oxidation during storage and freshness of lipid matrix. Peroxide values are used to indicate rancidity of oils. Oils with high degree of unsaturation will have greater peroxide values. It is also used for assessing the quality of oil. It is the amount of peroxide oxygen present in 1 kilogram of oil. It is expressed in units of mill equivalents. In general fresh oils have a peroxide value of less than 10 mEq/Kg while peroxide values in the 30-40 mEq/Kg range are generally associated with a rancid taste. Rancid oil forms harmful free radicals in the body which increase the risk of cancer, heart disease ,cellular damage and have been associated with diabetes, Peroxides accelerates ageing, raised cholesterol levels, obesity etc[35-37].

Peroxide value is useful as an indicator of oxidation at the initial stages; however, it is not related to the frying duration, but to the formation and breakdown of oxidation products. Peroxides are unstable and decompose at frying temperature. They may even increase after the sample is taken from the fryer. Hence, it is generally not a very reliable parameter to determine deterioration of frying oil quality. Moreover, poly-unsaturated oils have reduced stability at elevated temperatures; unsaturated fatty acids easily react with oxygen to form peroxides [38-40].

Para-anisidine value of oil is a measure of extent of secondary oxidation, occurred in the oil sample. As a whole this value also enables us to provide information about the extent to which oil has become rancid. When edible fats and oils are heated for deep- and pan frying, several kinds of decomposition compounds are produced. Free fatty acids and di- and mono-acylglycerols produced by the hydrolysis of triacylglycerols, and hydroxy- and oxo-fatty acids and polymerized compounds produced by the thermal oxidation are all polar compounds. Polar compounds are measured by column chromatography using silicic acid[41].

Total polar materials reflect the total level of breakdown products from the frying process. The amount and character of these products are affected by some frying parameters such as fat and food composition, frying conditions (temperature, oxygen exposure, heating time, turnover rate) and the design and material of frying equipment [42-43].

According to Bracco et al(1981) and Jorge et al (1996),the significant parameter that influences the formation of polar compounds in heated oils is the ratio of the surface oil area to, oil volume in the fryer. The specific surface also plays an important role in behaviour of oils during frying, as the overall deterioration is an oxidation process rather than an interaction with frying foods. The differences in temperatures do not cause significant changes in frying oils[44-45].

Measurement of total polar components (TP) is useful in estimating heat misuse in frying oils. Evaluating TP has been characterized as one of the best indicators of the overall quality of frying oils, providing critical information about the total amount of newly formed compounds having higher polarity than triacylglycerols [46]. TP in fresh frying oil include sterols, tocopherols, mono- and diglycerides, free fatty acids, and other oil-soluble components that are more polar than triglycerides [47].Other authors [48-49] also reported an increase in total polar components with heating, results that concur with findings in this study. Formation of total polar components, which indicates oil deterioration is strongly related to primary and secondary oxidation that takes place during frying. When the amount of total polar components reaches 25% levels, oil is considered to be thermally degraded and should be replaced with fresh oil[50]. Oxidation of oil is caused by aeration during frying that is promoted by bubbling of water provided by food. Thermal decomposition of lipids is generally observed during advanced heating to temperatures above 200 °C and results in the appearance of cyclic polymers and monomers [51].

The content of total polar compounds and acid value are the most predominant indicators for oil quality and are widely used in many international regulations[52-53]. For public health concerns, the content of total polar compounds and acid value in frying oil are regulated at not more than 25% and 2.0 mg KOH/g, respectively, in Taiwan. Determination of total polar compounds in frying oil provides a more robust measurement on the extent of deterioration in most situations[54] due to its higher accuracy and reproducibility. The contents of free fatty acid (FFA) and total polar compounds were commonly used for initial oil quality assurance and after-use frying oil quality assessment, respectively [55]. Nevertheless, the standard analytical procedure for oil quality evaluation needs to be done in a laboratory with proper equipment by skilled technicians [56].

The presence of excess polar compounds in repeatedly used frying oil has been associated with increased risk of developing hypertension [57]. Consumption of repeatedly heated cooking oil might increase the risk of developing atherosclerosis. Lipid peroxidation products induce oxidative stress in endothelial cells, resulting in endothelial dysfunction that could eventually lead to the formation of atherosclerosis [58]. Consumption of repeatedly heated cooking oil is also associated with increased total serum lipid and low density lipoprotein (LDL) levels [59]. Moreover, thermally oxidized lipids enhance peroxidation of membrane macromolecules, contributing to their mutagenicity and genotoxicity which could potentially lead to carcinogenesis.

Laws and regulations to control the quality of frying oil were adopted by some countries, including Belgium, France, Germany, Switzerland, the Netherlands, the United States and Chile. In Brazil, discontinuous frying processes are widely used both in home preparations as in restaurants and cafeterias. The oil is used in a large number of times with minimum replacement, which may result in high levels of change. However, Brazil does not yet have rules for monitoring and disposal of frying oils. These facts demonstrate the importance of studies to get to know the behavior of oil in discontinuous frying processes and their degree of change[60].

Aim of research study Therefore, it is important to understand the factors affecting the deterioration frying oil and to monitor the quality of collected frying oil samples were analysed for physicochemical parameters such as for Moisture, density, viscosity, AV, IV, PV, P-anisidine value, totox values and TPM were used to monitor deterioration of fried oil while it was used to authenticate oil samples using standards procedures. help of total polar compounds and peroxide value determination. The mechanism of thermal degradation of frying oil is complicated. Variables involved in the process include frying conditions, replenishment of fresh oil, original oil quality.

2. Material and Methods

The frying oils collected from different restaurants of main areas of Jalgaon city .In total 26 oil samples are collected (200ml each in clean plastic bottle) and coded A to D(26 samples) according to areas which performed daily frying operations. The most of restaurants used only one type of frying fat during measurements. The collected oil samples were analysed for Moisture, density, viscosity, AV, IV, PV, P-anisidine value, totox values and TPM were used to monitor deterioration of fried oil while it was used to authenticate oil samples using standards procedures. The obtained results are compared to each other with codex safety standards. The measurements were performed in daily frying operations of these restaurants and were analysed repeatedly for the relevance of results. In total were evaluated 16 samples of oils and fats that were divided according to raw materials. The types of oils and fats used for frying are summarized in Table 1. The most of restaurants used only one type of frying fat during measurements. All the chemicals reagents and glassware used in this analytical work are analytical grade.

2.1. Experimental procedures

The collected oil samples were analysed for Moisture, density, viscosity, AV, IV, PV, P-anisidine value, totox values and TPM were used to monitor deterioration of fried oil while it was used to authenticate oil samples using standards procedures.

2.1.1. Determination of Moisture Content [61-68]

Five grams of oil sample for all the collected oil samples were heated to constant weight in a vacuum oven at 102°C, for three hours. Then they were cooled in efficient desiccators, for 30 minute and weighed. Constant weight was attained when successive 1 hour draying periods showed additional loss, 0.05%. . the moisture content was determined using:

% of moisture = w1-w2 X100 /w

2.1.2. Determination of density at 300C

It was determined by Aston paar 5000 Densitometer have been used for the determination of density of the refined vegetable oil at $30^{0}C$ used in the present investigation, an instrument can be calibrated with distilled water at room temperature.

2.1.3. Determination of viscosities

Measured Viscosity of various brands of vegetable oil before and after frying using Haake Rheowin Viscometer: flow characteristics for viscosity, Take 50ml sample of the original oil in the container set the instrument with water circulating for control of temperature thermostat as per manuals, the viscosity determine at the $27\ ^{0}C$ temperature. Take the reading of pure vegetable oils before and after frying which are shown in Table 1.

2.1.4. Determination of Acid value:

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

2.1.5. Determination of Iodine value:

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

2.1.6. Determination of 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).

2.1.7. Determination of p-anisidine Value:

The p-anisidine value was obtained using a double beam spectrophotometer (UV 2300, LabIndia) according to the AOCS method Cd 18-90 (AOCS, 1989d).

2.1.8. Determination of Total Polar compounds [61-68]

Semi-solid and solid samples were heated at temperature just above their melting point and filtered to remove visible impurities. Then 2.5 g sample precisely weighed was placed in a 50 mL flask and dissolved with 20 mL of solvent mixture composed of 87% petroleum ether and 13% diethyl ether with slight heating. After cooling at room temperature and adjusting to volume with the same solvent mixture, polar and nonpolar components were separated by chromatography by pouring the sample at the top of the column. Elution was done with 150 mL of the previous solvent mixture. The eluate was collected in a round bottom flask then concentrated by distilling the solvent on a rotary evaporator at about 40°C to about 5 ml. The remaining solvent was then evaporated to dryness under stream of analytical grade nitrogen (99.999%).Each sample was analyzed in triplicate. The estimation and calculation of the TPC of the oil samples were done according to the method and equation.

TPC (%)= oil mass (mg)- nonpolar compounds (mg)/oil mass(mg)*100

2.1.9. Totox value [61-68]

Finally the totox value was calculated and which was equal to the sum of the p-anisidine value plus twice the peroxide value. Totox value indicates the total oxidation of a sample using both the peroxide and *p*-anisidine values. Totox value can be calculated by using the formula:

TV = (2 x PV) +AV.

3. Experimental test results of physicochemical characteristic of frying oils collected from different places of Jalgaon city are given in Table 1.

Code	Moist (%)	Density (g/cm^3 20 °C)	*AV (mgKOH/g)	Viscosity (mm^2/s 28 °C)	IV (gI$_2$/100g)	PV (meq/kg)	P-AV (meq/kg)	TPM (%)	Totox Value
A1	0.34	0.9193	0.56	44.48	82.29	9.87	10.14	17.5	29.88
A2	0.25	0.9245	0.97	39.82	85.68	10.65	11.15	15.5	32.45
A3	0.11	0.9262	0.65	42.38	97.30	10.69	11.16	13.68	32.54
A4	0.09	0.9274	1.74	39.90	95.90	9.78	10.12	16.5	29.68
A5	0.07	0.9216	0.85	35.20	80.88	8.78	10.15	12.28	27.71
B6	0.05	0.9184	1.3	33.98	112.60	9.56	9.83	13.5	28.95
B7	0.09	0.9233	1.83	34.80	109.20	10.3	11.12	15.12	31.72
B8	0.12	0.9208	2.05	33.78	115.87	9.18	10.21	13.5	28.57
B9	0.06	0.9224	2.13	34.89	118.26	11.69	12.17	15.98	35.55
C10	0.08	0.9188	3.25	39.64	120.8	12.78	13.16	14.54	38.72
C11	0.09	0.9265	1.72	40.52	119.8	13.56	14.18	13.0	41.3
C12	0.05	0.9232	4.48	39.88	120.4	10.65	12.17	14.34	33.47
C13	0.04	0.9208	1.29	42.40	122.90	10.78	11.90	10.24	33.46
C14	0.07	0.9277	3.25	35.20	109.10	11.65	11.14	10.5	34.44
C15	0.11	0.9210	4.31	39.90	110.24	9.78	10.15	13.5	29.71
D16	0.10	0.9238	0.56	34.88	96.48	9.56	10.16	14.0	29.28
D17	0.08	0.9228	0.85	36.98	118.88	11.14	12.12	18.5	34.4
D18	0.07	0.9268	3.23	37.70	112.58	10..3	12.15	19.0	32.75
D19	0.13	0.9219	4.48	33.80	109.20	11.84	12.14	20.0	35.82
Total	2.0	17.54	39.5	720.13	2038.36	192.24	215.32	281.18	620.4
Mean	0.11	0.92	2.08	37.90	107.28	10.12	11.33	14.79	32.65
SD	0.17	0.35	0.03	0.53	0.16	0.87	0.69	0.38	0.26
CV	157.46	37.65	1.27	1.39	0.15	8.58	6.13	2.55	0.8
SEM	0.09	0.2	0.02	0.31	0.09	0.5	0.4	0.22	0.15

(*AV-acid value, IV-Iodine value, PV-peroxide value, TPM-total polar material, SD-standard deviation, CV-coefficient of variation, SEM standard error)

Table2.Test results of frying oils and codex standards

Sr. no	Test	After frying	Codex Alimentarius commission standard	FSSAI
1	Moisture%	0.05-0.34%	0.15-0.2	0.03%
2	Viscosity(mm^2/s 28 °C)	33.78-44.48	--	28.8-35.2
3	Density(g/cm^3 20 °C)	0.9188-0.9277	0.899-0.920	0.91-0.93
4	Acid value	0.56-4.31mg KOH/g	0.6 mg KOH/g	0.5-6.0 mg KOH/g
5	Peroxide value	8.78-13.56 MeqO$_2$/Kg	10.0 MeqO$_2$/Kg	1-10 MeqO$_2$/Kg
6	P-anisidine value	9.56-14.18 MeqO$_2$/Kg	20 MeqO$_2$/Kg	--
7	Totox value	29.28-41.3 MeqO$_2$/Kg	26 MeqO$_2$/Kg	--
8	Total polar compounds%	10.24-20.0%	Upto 24%	25%

4. Statistical analysis

The data obtained from the experimental measurements and accuracy of different parameters for different frying oils have been analysed and the Statistical parameter like standard deviation, coefficient of variance and standard mean error were calculated for Moisture, density, viscosity, AV, IV, PV, P-anisidine value,totox values and TPM for different frying oils. 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 figure1to2.

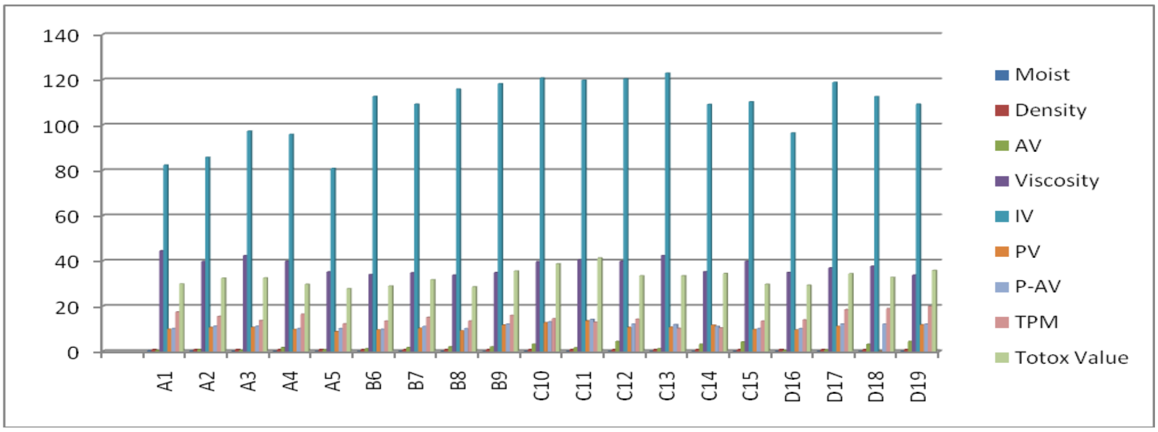

Figure1 shown that different oxidative parameters of frying oils

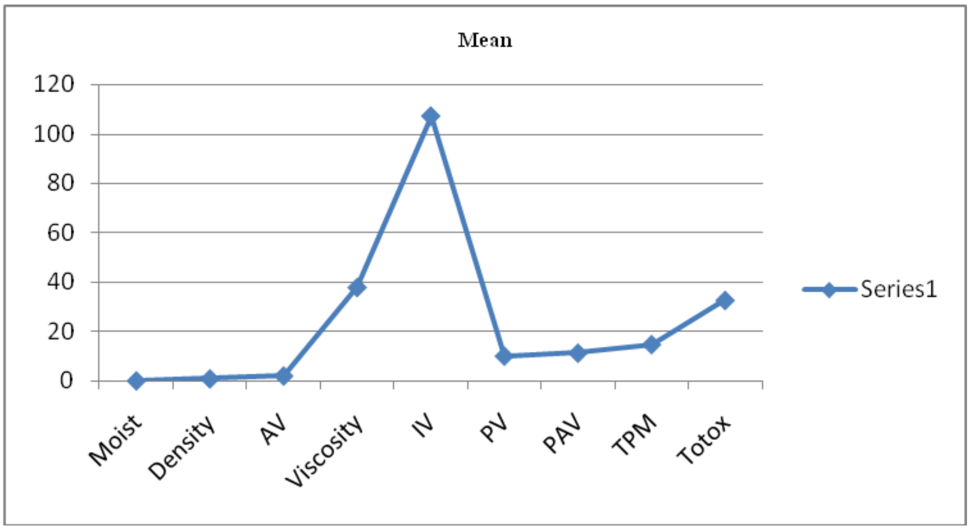

Figure 2 Accuracy and descriptive Statistics of different frying oils from different parts of Jalgaon city, Maharashtra, India as shown in figure

5. Result and discussion

All results determined are shown in Table 1.When the waste frying oil samples obtained from fast-foods are examined for physiochemical parameters such as Moisture, density, viscosity, AV, IV, PV, P-anisidine value, totox values and TPM were used to monitor deterioration of fried oil while it was used to authenticate oil samples. The obtained results of the different frying oil samples are A and D coded and the obtained results are compared to each other. In this study, It is seen that, the results showed that in the range of 0.05-0.34(±0.17)in case of water content which is exceeded, In case of density it is in the range of 0.9188-0.9277(±0.35) which are increased, 33.78-44.48 (±0.03) it is seen in viscosity which are higher as compared with the safety limit, It is seen in case of acid value, 0.56-4.31(±0.53) which are increased, in case of IV,80.88-115.87(±0.16)which are generally low as the result of destruction of double bonds, the result was not in this expectation. while in case of PV it is in the range of 8.78-13.56 (±0.87)which are higher as compared with codex limit of 10 meq/kg,The P-anisidine value are in between 9.56-14.18 (±0.69) which are in the limit of 20 meq/kg,The totox value are in the range of 29.28-41.3(±0.38) which are highest and higher than the top limit of 26 meq/kg and deviates codex standards and TPM value are within limit of less than 25%,It is 10.24-20.0 (±0.26) respectively. The AV, PV and totox values which were significantly higher compared to the Codex Alimentarius Commission standards. Peroxide values of 8.78-13.56 ± 0.87 meq O2/kg deviated from the Codex standard value of 10 meq O2/kg,this may be explained by splitting of hydro peroxides which form during the first stage of the oxidation. Acid values of 0.56-4.31±0.53 mg KOH/g, which were significantly higher compared to the Codex Alimentarius Commission standards. In general, it was seen that, fast-food origin waste frying oils' viscosities, water contents and AVs were higher and iodine values were lower than those from other sectors. The densities of all the samples were generally close to each other. The results showed degradation in the physico-chemical properties of the vegetable cooking oil after repetitive frying. Furthermore the result of the same sample had the highest density, viscosity, water content and lowest iodine value

6. Conclusion

As per the present results, the TPM, peroxide value and p-anisidine values of frying oils are significantly increased during repeated use for frying. The physico-chemical oxidation of oils at frying temperature 200^0C was increased to more than 20 meq / kg which evidenced by the obtained results. Repeated usage of same frying oil, the rancidity is notably increased. Thus, the increased rancidity spoils the quality of food and on eating such food causes many acute problems on health like diarrheal diseases, gastric, ulcer etc. Specific laws on the subject are also lacking in order to provide means for the health surveillance agencies to be able to act more rigorously, both in supervisory and in guidance aspects. Thus, it is advisable and expected to monitor and to achieve better control of the frying and provide proper rapid measuring device and hence better quality fried food, maintaining the health of the population. Field studies incorporating home visits should be done in order to truly evaluate the types of oils used and also to measure the actual level of toxic and polar compounds and peroxide value found in frying oils used in home kitchens. Education programs concomitant with more vigilance from administrative organizations may additionally help in the improvement.

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