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The Quality of Oils / Fats Used in Selected Deep Fried Snacks Sold by the Street Vendors in Guntur Town

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ABSTARCT

Deep fat frying is one of the oldest and popular methods, which involves the process of rapid heat transfer when the food is placed in oil at high temperatures at 175 – 195 ºC. Repeated frying leads to many oxidative and thermal reactions due to which physical, chemical and nutritional changes take place in oil that affects the quality of oil. Through a structured questionnaire the information related to vending practices by the vendors selling *samosa, bajji, punugu and jilebi* was collected. Three chemical parameters, namely, free fatty acids (FFA), Peroxide value (PV) and Iodine value (IV) of fresh and used oils were studied. The results showed that there was no significant difference in FFA among fresh oils (P – 0.758) and also among used oils (P – 0.63). There is no significant difference in the PV among the 4 fresh oils (P - 1.598) and there was a significant difference in PV of used oils (P - 0.0195). There is no significant difference in the IV among the 4 fresh oils (P – 0.203) and also in IV of used oils (P – 0.103). There was no significant difference (P > 0.05) in the FFA content of the fresh oils of all foods except in case of *samosa* when compared to the standard FFA. The FFA content of used oils was highly significant. The PV of all fresh oils and all used oils were highly significant (P< 0.01) when compared to the standard PV of palm oil. The P – values of IV of fresh oils and used oils were highly significant (P < 0.01) when compared with the standard IV of palm oil. There was a significant difference (P < 0.01) between the fresh and used oils with respect to FFA and IV while there is no significant difference (P – 0.41) in the PV of fresh and used oils.

Key words: *Deep frying, Deep fried foods, Free fatty acids, Iodine value, Oils, Peroxide value, Quality of oil, Street foods*

Oils and fats play a crucial role in the metabolic reactions in the living organismS. The human body utilizes oils and fats in the diet as energy source for structural component and for making powerful biological regulators (Khan *et al*., 2007). Fats can be obtained from both plant and animal origin. Vegetable oils and fats have wide application in foods where they are used in fryings, salad dressings, cooking, shortening, margarine and in ice cream manufacturing (Anthea *et al.,* 1993). With regard to the quality control of edible oils, chemical parameters such as iodine value (degree of unsaturation), peroxide value, free fatty acids as well as other properties determine the quality of oil. Palm oil (*Elaeis guineensis*) is a form of edible vegetable oil which is the second most widely produced oil after soy bean oil (Tesfaye and Abebaw, 2016). The process of deep fat frying is carried out near the temperature of 175 – 195 ^{0}C. Due to high temperature and presence of air and moisture, many physical and chemical changes occur in the food causing oxidative degradation of oil (Aladedunye, 2009). During frying, hydroperoxide compounds are formed, which is a good sign of lipid oxidation under normal conditions. Polyunsaturated fatty acids have lesser stability at higher temperatures and form peroxides by easily reacting with oxygen (Diop, 2014). But the unhygienic conditions in which the snack foods are prepared, stored and served pose a question regarding its quality (Nazni and Jaganathan, 2014). Hence current study is planned to understand the quality of fats used in street foods in Guntur town.

MATERIAL AND METHODS

The chemical parameters were analyzed by using standard AOAC methods. Through a structured questionnaire the information is collected regarding number of street food vendors, their food preparation and selling practices, type of oils used and number of times the oils are been used for frying, other observations including the environment in which the foods are prepared or sold and personal hygienic practices followed by the vendors as well as hygienic condition of carts/ cooking utensils. The city was divided into four quadrants and fifteen vendors who were selling the selected foods (*samosa, bajji, punugu and jilebi*) were selected by using Random sampling techniques and the oil samples were collected from the selected vendors for the analysis. Three chemical parameters, namely, Free fatty acids (FFA), Peroxide value (PV) and Iodine value (IV) of fresh and used oils were studied. As the survey was conducted by using the questionnaire the percentage of vendors using the same practices or any unhealthy practices were known.

Procurement of Chemicals for Analysis

Ethanol, phenolphthalein, sodium hydroxide, glacial acetic acid, chloroform, hydrochloric acid, potassium chromate, potassium iodide, sodium thiosulfate, soluble starch, potassium chromate, concentrated hydrochloric acid, Glacial acetic acid (free from ethanol), carbon tetra chloride (analytical reagent grade), iodine mono – chloride (ICl), potassium iodide (free from potassium iodate) – 10% solution prepared fresh, starch solution, wij's iodine monochloride solution are the chemicals that were used for analysis.

Free Fatty Acids

Free fatty acid of both fresh and used oil samples was determined by AOAC (1990) method. Acid value or free fatty acid value depicts the amount of fatty acids hydrolyzed from triacylglycerols. Free fatty acid value is defined as, milligrams of potassium hydroxide needed to neutralize the free acids present in 1g of fat or oil.

Procedure

Five grams of oil was taken and filtered using filter paper to remove the impurities. The filtered oil was taken into a 250 mL Erlenmeyer flask. To this, 100 mL of neutralized ethanol and 2 mL of phenolphthalein indicator was added. The mixture was completely dissolved by shaking it well. The solution was titrated with standardized 0.1 N NaOH till the end point is reached which was indicated by the slight pink color that remained for 30 sec. The initial and final volume of titrant was recorded.

Peroxide Value

Peroxide value of both fresh and used oil samples was determined by AOAC (1990) method. The amount of milliequivalents of peroxides per kilogram of fat is the peroxide value that is determined by titration method to measure the amount of peroxide or hydroperoxide groups.

Procedure

Five grams of fat (fresh and used) was collected and filtered using filter paper to remove the impurities. Filtered oil samples were taken into each of the two 250 ml Erlenmeyer flasks. To this, 30 ml of prepared acetic acid – chloroform solution was added and mixed well to dissolve. To this solution**,** 0.5 ml saturated KI solution was added and allowed to rest for 1 min and then 30 ml of distilled water was added. The samples were titrated with 0.1 N sodium thiosulfate solutions and a vigorous mix was given, such that the yellow color almost disappeared. And then 0.5 ml of 1% starch solution was added by continuing the titration and shaking vigorously to liberate all iodine from chloroform layer, till blue color disappears. The volume of titrant used was noted.

Iodine Value

Iodine value of both fresh and used oil samples was estimated by using the method AOAC 920.159 (2000). The test sample added in carbon tetrachloride is treated with known amount of excess iodine monochloride solution in glacial acetic acid (Wij's solution). The excess of iodine monochloride is treated with potassium iodide and liberated iodine is estimated by titrating with sodium thiosulfate solution.

Procedure

Five grams of oil sample was weighed in a 500 ml conical flask with glass stopper, which was added with 25 ml of carbon tetra chloride. The content was mixed well. To this content 25 ml of Wij's solution was pippetted out and added to the mixture. The mixture was stirred well and rested for half an hour. Simultaneously, experiment with blank solution was carried out. After resting, 15 ml of potassium iodide solution was added along with recently boiled and cooled 100 ml of water. The liberated iodine was titrated with sodium thiosulfate solution that was standardized, by using starch as an indicator until the blue color that was formed disappeared after thorough mixing.

Paired comparison t – test was followed to compare the values of fresh oil samples and used oil samples for all three chemical parameters (IV, PV and FFA). Significant difference between foods with regard to each chemical parameter was tested using one way ANOVA. Comparision of values for chemical parameters obtained in the present study with standard values was done using one sample t – test for both fresh and used oil samples.

RESULTS AND DISCUSSION

The obtained mean values of the analysis of all the chemical parameters (FFA, PV and IV) are presented in table 1, table 2 and table 3 respectively. The mean values of FFA of fresh oils of *samosa, bajji, punugu and jilebi* were 12.1, 12.95, 13.7 and 11.36 and mean values of FFA of used oils were 7.57, 7.6, 7.98 and 7.23 respectively. There was no significant difference in FFA among fresh oils (P – 0.758) and also no significant difference among used oils also (P – 0.63), which shows that not much difference between in FFA among all the foods and vendors. The results of the present study show that FFA of fresh oils was more than FFA of used oil which is not usual. Perhaps, there was an mixing of fresh oil with previous day's heated and stored oils which was further oxidized leading to the formation of aldehydes, ketones and acids

Table 1. Mean values of FFA, PV and IV of fresh oils and used oils

Food products	Free Fatty Acids		Peroxide value		Iodine value	
	Fresh oils	Used oils	Fresh oils	Used oils	Fresh oils	Used oils
Samosa	12.10	7.57	19.50	19.00	8.72	8.37
Bajji	12.95	7.60	22.50	23.33	8.79	8.13
Punugu	13.70	7.98	24.16	25.66	8.82	8.42
Jilebi	11.36	7.23	25.50	24.33	8.81	8.69
F cal.	0.39	0.59	4.91	3.65	1.59	2.17
P – value	0.758 NS	0.63 NS	1.598 NS	0.0195*	0.203 NS	0.103 NS
CD	10.08	4.98	11.24	12.79	1.98	4.10
CV %	1.58	2.40	5.60	7.22	0.04	0.18

Note: * Significant at 0.05 levels
NS Not significant at 0.05 levels

Table 2. Comparision of Free fatty acids of oil samples with standard values

	Free Fatty Acids of Fresh oils compared with standard values				Free Fatty Acids of Used oils compared with standard values			
Foods	Test value	Mean ± SD	*t* - value	*P* - value	Test value	Mean ± SD	*t* - value	*P* - value
Samosa	10	12.10 ± 4.37	1.668	0.12NS	10	7.57 ± 1.73	4.844	0.001**
Bajji	10	12.95 ± 6.11	1.675	0.12NS	10	7.60 ± 0.85	9.772	0.000**
Punugu	10	13.70 ± 5.23	2.45	0.032*	10	7.98 ± 1.33	5.234	0.000**
Jilebi	10	11.36 ± 6.53	0.722	0.48NS	10	7.23 ± 1.43	6.689	0.000**

Note: * Significant at 0.05 levels
** Significant at 0.01 levels ;
NS Not significant at 0.05 levels

Table 3. Comparision of Peroxide values of oil samples with standard values

	Peroxide values of Fresh oils compared with standard values				Peroxide values of Used oils compared with standard values			
Foods	Test value	Mean ± SD	*t* - value	*P* - value	Test value	Mean ± SD	*t* - value	*P* – value
Samosa	15	19.5 ± 3.42	4.55	0.001**	15	19.0 ±5.68	2.43	0.033**
Bajji	15	22.5 ± 4.90	5.29	0.000**	15	23.3 ±5.86	4.92	0.000**
Punugu	15	24.1 ± 3.56	8.91	0.000**	15	25.6 ±3.60	10.26	0.000**
Jilebi	15	25.5 ± 4.10	8.86	0.000**	15	24.3 ±5.44	5.93	0.000**

Note: * Significant at 0.05 levels
** Significant at 0.01 levels ;
NS Not significant at 0.05 levels

Table 4. Comparision of Iodine values of oil samples with standard values

	Iodine values of fresh oils compared with standard values				Iodine values of Used oils compared with standard values			
Foods	Test value	Mean ± SD	*t* - value	*P* - value	Test value	Mean ± SD	*t* - value	*P* - value
Samosa	10	8.72 ±0.23	19.04	0.000**	10	8.37 ± 0.71	7.82	0.000**
Bajji	10	8.79 ±0.06	66.31	0.000**	10	8.13 ± 0.49	13.15	0.000**
Punugu	10	8.82 ±0.05	75.49	0.000**	10	8.42 ± 0.58	9.26	0.000**
Jilebi	10	8.81 ±0.04	83.9	0.000**	10	8.69 ± 0.22	20.1	0.000**

Note: * Significant at 0.05 levels
** Significant at 0.01 levels ;
NS Not significant at 0.05 levels

Table 5. Comparision of chemical properties between fresh oils and used oils.

	Free fatty acid value for fresh and used oils	Peroxide value for fresh and used oils	Iodine value for fresh and used oils
Paired t – test value	5.887	0.227	4.591
P - value	0.00*	0.41NS	0.00*

Note: * Significant at 0.05 levels
NS Not significant at 0.05 levels

of lower molecular weight, consumption of which may further lead to negative health effects.

The mean values of peroxide value of fresh oils of *samosa, bajji, punugu and jilebi* were 19.5, 22.5, 24.16 and 25.5 respectively and the PV of used oils of 4 foods were 19, 23.33, 25.66 and 24.33. There is no significant difference in the PV content among the 4 fresh oils (P - 1.598) and there was a significant difference in PV content among the oils used for frying the 4 products (P - 0.0195). Depending on the obtained results, the oils can be classified into moderately oxidized oils and highly oxidized oils. Oil with high peroxide value between 5 and 10 meq/g is at moderate oxidation and above 10 meq/g is classified as a high oxidation state (Moigradean *et al.,* 2012). Perhaps, due to repeated usage of the same oil, bad frying practices and storage of oil by using different methods, the rate of oxidation increases that results in the formation of peroxides. In this study, the peroxide values of all the oil samples were found to be above 10 meq/g.

The mean values of IV of used oils of *samosa, bajji, punugu and jilebi* were 8.72, 8.79, 8.82 and 8.81 respectively and the IV of fresh oils of 4 foods was 8.37, 8.13, 8.42 and 8.69. There is no significant difference in the IV content among the 4 fresh oils (P – 0.203) and also in IV of used oils of 4 products (P – 0.103). The decrease in the iodine value after heating of oil is due to more intensive thermo oxidative transformations that occur compared to heated oil containing food. The decrease of iodine value is because of the destruction of double bonds by oxidation, scission and polymerization (Tynek et al., 2001 and Cuesta et al., 1991).

The comparision of chemical parameters (FFA, PV and IV) with their standard values are presented in the table 4. The standard value for FFA content of palm oil is generally considered as 10 mg KOH/ g of oil. There was no significant difference (P > 0.05) in the FFA content of the fresh oils of all foods except *punugu* when compared to the standard FFA of palm oil. However, the fresh oil used for frying *punugu* showed a significantly higher (P – 0.032) FFA when compared to the standard expected value. The oils used for frying all four foods are significantly higher (P – 0.00) FFA when compared to the standard expected value. The standard for PV was taken as 10 - 20 mEq / kg. The PV of all fresh oils used for those foods were highly significant (P < 0.01). The PV of the oils used for *samosa* was highly significant at 5% level (P – 0.033) and remaining oils used for other foods show highly significant at 1% (P < 0.01). The standard value of IV of palm oil was taken as 10 for 2.5 g of fat (45 – 56 / 100g). The P – values of IV of fresh oils were highly significant (P < 0.01) and also P –value of used oils were highly significant (P < 0.01) which shows that

there was a significant difference when compared to standard values.

The values of chemical parameters namely FFA, PV and IV of fresh oils and oils used for deep frying of *samosa, punugu, bajji and jilebi* were compared with each other. The results are shown in table 5. The data showed there is a significant difference ($P < 0.01$) between the fresh and used oils with respect to FFA and IV while there is no significant difference ($P - 0.41$) in the PV of fresh and used oils.

CONCLUSION

It can be concluded that the chemical parameters were highly changed after number of fryings that affects the quality of oil. The FFA and PV of foods sold by few vendors were more and IV was less which shows that the quality of oils is less and deteriorated with each frying. This may also affect the quality of food, which if consumed may lead to health problems. Occurrence of various chemical changes that take place in the oils as well as foods may pose a threat to the consumers and may have a negative impact on health.

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