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Original Article

Assessment of Quality Parameters in Edible Vegetable Oils

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ABSTRACT

Objectives: Edible oils, derived from a plant source, play a vital role in providing nutrition. A quality edible oil has a flavor, range of physicochemical parameters. Several quality parameters like saponification value, acid value, peroxidase value and iodine value will be helpful in estimating the quality of edible vegetable oils. The present study was intended to evaluate the quality difference between cooked and uncooked oils. **Materials and Methods:** Utilizing various edible oil samples from major brands in india e.g sunflower oil, soybean oil, canola oil, almond oil, coconut oil and, olive oil saponification value and acid value was determined. All the oil samples were thoroughly characterized by calculating their saponification value and acid value using the standard procedure of association of official analytical chemist (AOCS) and American oil chemist society. **Results:** In comparision to uncooked oils, cooked oils had significantly higher sapnification values. The acid values were also increased in cooked oils compared to uncooked oils. Widely used sunflower oil had a two fold significant increase in saponification value and five fold significant increase in acid value after cooking. Similar changes were not observed in olive oil. **Conclusion:** Taken together, results of our study indicate that widely used sunflower oil might not be appropraiate for domestic usage. Further, our results also indicate that olive oil might be a better choice for domestic cooking. Further studies are required for a large scale validation of the present results there by brining in regulation/public health policy on usage of cooked oils by various small scale food vendors.

Key words: Edible vegetable oil, Saponification value, Acid value, Cooked oil, Quality parameters.

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INTRODUCTION

Edible oil and fats have been used for centuries in India and ghee produced from bovine milk is the primary source of lipids in people diet. Several other vegetable oils e.g., coconut oil, palm oil[1,2] were are reported to be used for domestic cooking since times immemorial. Hence there is no revelation that the analysis of oil and fat has a long history. Over time various types of edible oils emerged from alternative sources due to high demand in nutritional supplemention. Edible vegetable oils derived from a wide variety of plant and plant seed e.g., mustard oil, soybean oil, sunflower oil, rice bran oil, groundnut oil, etc. are used in many attributes of household and global food production. Edible oil which are primarily used for cooking purpose also used in traditional medicine for the treatment of cold, cough, bronchitis, edema, burn, and used in conventional treatment method (panchakarma) in Ayurveda.[3] Edible oil plays an essential role in daily food and contributes to the diet of people.[4] In terms of energy source, oil is the second component after carbohydrate, which is utilized to provide energy to the living cells. The edible oils are good source of fatty acid and lipid for human nutrition, which mainly involves in repairing tissues and in formation of new cell. Oils and fats are significant source of essential fatty acid, as well as carriers of fat-soluble vitamins like Vitamin A, D, E and Vit K.[5-7]

Edible oils are used in domestic cooking either in processed form or unprocessed forms. Processed oils also known as refined oils which are primarily used for cooking purposes in india contains significantly less amount of essential fatty acid as compared to non- refined oil.[8] Fatty acids play an imperative role in the production of energy by fatty acid oxidation, membrane synthesis, cell proliferation, acylation of protein which plays a key role signalling pathways[9] and synthesis of acetyl coenzyme as an end product of fatty acid utilization.[10-12]

Frying food in oil became the popular method of food preparation now a days. Currently services of fast food centers continuously increasing all over the world and consumption of fried food items like french-fries, fried chicken etc. has changed the eating habits.[4] Repeated cooking of oil leads to harmful concentration of fatty acid degradation products there by decreasing the quality of cooked oil. This is the reason why there is huge concern about food safety and consumer's health now a days. With consideration of human health and safety, various analytical parameters were fixed for oils by the World Health Organization (WHO) and Food and Drug Administration (FDA). Analytical methods like Saponification value (SVs), Acid value (AV), iodine value, peroxide value, water content, oxidation stability, free fatty acid and nickel trace using polarography[13,14] were used to evaluate the quality of oils. In this article, we delineate the saponification value and the acid value of the six types of oils. Sunflower oil, soybean oil, canola oil, almond oil, coconut oil, and olive oil); both values investigate for cooked oil as well as uncooked oil. This investigation was designed to collect and provide necessary data for the regulation of the quality of oil used for frying fast food products.

MATERIALS AND METHODS

Reagents and standards

Samples of sunflower oil, soyabean oil, canola oil, almond oil, coconut oil and olive oil were obtained from different manufactures in the local market. The KOH solution (potassium hydroxide) was used as a solvent and std. HCl 0.5N was used for titration following the conventional method. 0.1 N NaOH (sodium hydroxide) solution was used for the determination of acid values. Phenolphthalein indicator solution was made by dissoving 1 gram phenolphthalein in 100 ml of 95% ethanol.

Preparation of alcoholic Potassium hydroxide (KoH) solution

1.2 litter alcohol was refluxed for 30 min along with 10 gm KOH and 6 gm granulated aluminum or aluminum foil. The initial 50 ml of solution discarded and then one litter solution was collected through the distillation process. 40 gm of potassium hydroxide pellets were added to one litter alcohol under the maintain temperature of 17°C while dissolving the soluble base. Allowed to stand overnight and discard the clear liquid. Thus prepared alcoholic potassium hydroxide was bottled and tightly closed with a rubber stopper.

Preparation of 0.5 N standard hydrochloric acid

300 ml of deionized water was added to the laboratory volumetric flask followed by slow addition of 82.807 ml 37% HCl stock solution. Volume was then made up to 1000ml using deionized water. 0.5N HCl solution was then prepared by diluting 1N HCl stock solution.

Frying procedure

Sunflower oil samples were obtained from local street food vendors. Deep frying of chicken nuggets and french fries using sunflower oil is carried out at 150-180°C for 5 min and the same procedure was repeated for 20 cycles. Similar frying procedures were maintained for soyabean oil, canola oil, almond oil, coconut oil and olive oil at home using gas burners and samples were collected for analysis.

Estimation of saponification values

The saponification value was regulated by the conventional method. The sample was melted to make it a liquid and filtered through a filter paper to remove any impurities present in the sample and last trace the moisture. Weigh about 1.5-2.0 gm of the dry sample into a 250 ml round bottom flask (Erlenmeyer flask), and 25 ml of alcoholic KoH 0.5N (Potassium hydroxide) was added. The flask was connected to the condensing unit and boiled for 15-20 min until complete saponification of oil or till the disappearance of oily matter and appearance of a clear solution, which was mainly achieved within one hour of boiling. After the sample gets cooled, subsequently, 0.5N HCl was used for titration using a 10 ml phenolphthalein indicator.[15] The titration process was continued until the pink colour of the sample get vanished.[16] Each experiment was performed in triplicate to get the average reading and Standard Deviation. The entire process was performed for the cooked oil samples as well as non-cooked samples reading, which was noted and tabulated. Blank was carried out using the same volume of water instead of the KOH solution.

Estimation of acid value

The acid value was also determined by the conventional method. Weigh about 1.5-2.0 gm of cooked oil sample into a 250 ml round bottom flask (Erlenmeyer flask) and 50 -100 ml freshly neutralized hot ethanol added to the conical flask. 1ml phenolphthalein indicator added to the mixture and boiled for 5 min; immediately, the mixture was titrated against the 0.1N NaOH; during the titration process, the solution was shaken continuously until the colour of the solution turns into pink.[16] Each experiment was performed in triplicate to get the average reading and standard deviation. The whole process was performed for the cooked oil samples as well as non-cooked oil samples reading were noted.

RESULTS

The acid values and saponification values were investigated using samples of sunflower oil, soyabean oil, canola oil, almond oil, coconut oil and olive oil. Volumetric titrations were carried out using alcoholic KOH and NaOH solutions for obtaining saponification values and acid values respectively. During saponification process pink coloured solution turning colourless was considered as end point of the reaction as shown in Figure 1a; the change of colour from pink to colourless indicated the reaction between alkali compound and acid compound. Similarly, during the acid value determination, which mainly shows the presence of free fatty acids in the oil. The clear solution turns in to pink as mentioned in Figure 1b. The value of saponification and acid was calculated by eq. 1 and eq. 2. Respectively

$$\text{Saponification Value} = \frac{56.1 \times N \times (B - S)}{W} \quad (1)$$

Where W stands for the weight of the sample in (g), B for the volume of standard HCl required for the blank, S represents the volume of standard HCl required for the sample, N indicates normality of the HCl.

$$\text{Acid value} = \frac{56.1 \times V}{W} \quad (2)$$

Where W stands for the weight of the sample in (g), V represents the volume of alkali used for titration (in ml) and N for the normality of the alkali.

Analysis of saponification value and acid values

Six different types of edible oils (uncooked oil and cooked oil) were examined using standard procedure of association of official analytical chemist (AOAC) and American oil chemist society (AOCS).[17,18] Saponification and acid value of sunflower oil, soybean oil, canola oil, almond oil, coconut and olive oil are extensively investigated for SV and AV before cooking and after cooking. The data obtained after estimating saponification value and an acid value of all six types oil samples was illustrated in Table 1. Saponification value (SV), acid values are quality parameters that are of extensive significance in edible oil. Among all oil samples we observed a huge variation in saponification values before cooking and after cooking, which is 55.9 and 112.6 for sunflower oil, 84.4 and 102.5 for soybean oil 114.3 and 155.01 for canola oil 82.4 and 106.0 for almond oil, 95.2 and 124.4 for coconut oil, for olive oil 69.5 and 79.74 mgKOH/gm. There was a significant increase in saponification value after cooking all the oil samples Figure 2.

Acid value is mostly used to suggest the level of rancidity and edibility of oil. Acid value of all oil samples before cooking and after cooking were

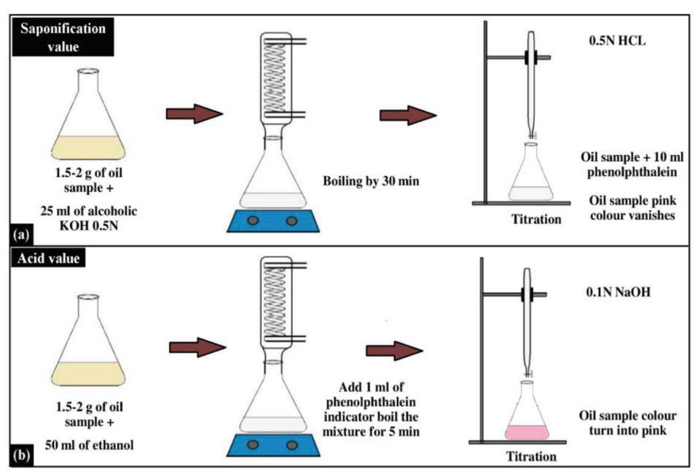

Figure 1: Schematic representation of physicochemical analysis performed. (a) Saponification value (b) Acid value.

Table 1: Physicochemical properties of cooked and uncooked oils.

S. No	Sample oil	Saponification value (uncooked oil) (mg KOH/g of oil)	Saponification Value (cooked oil) (mg KOH/g of oil)	Acid Value (Uncooked oil) (mg NaOH/g of oil)	Acid Value (cooked oil) (mg NaOH/g of oil)
1.	Sunflower oil	55.93±0.0568	112.601± 0.0964	0.2833± 0.0115	1.1433± 0.1556
2.	Soybean oil	84.45± 0.2612	102.501± 0.3235	1.1001± 0.4035	2.7733± 0.1556
3.	Canola oil	114.33± 0.5686	155.03± 0.1150	2.2666± 0.0513	2.3033± 0.1686
4.	Almond oil	82.43± 0.2402	106.00± 0.1044	0.9444± 0.0701	1.4833± 0.4157
5.	Coconut oil	95.20± 0.1951	124.40± 0.2696	0.3166± 0.0493	2.1966± 0.0585
6.	Olive oil	69.57± 0.0513	79.74± 0.1486	6.4266± 0.1159	6.4333± 0.0585

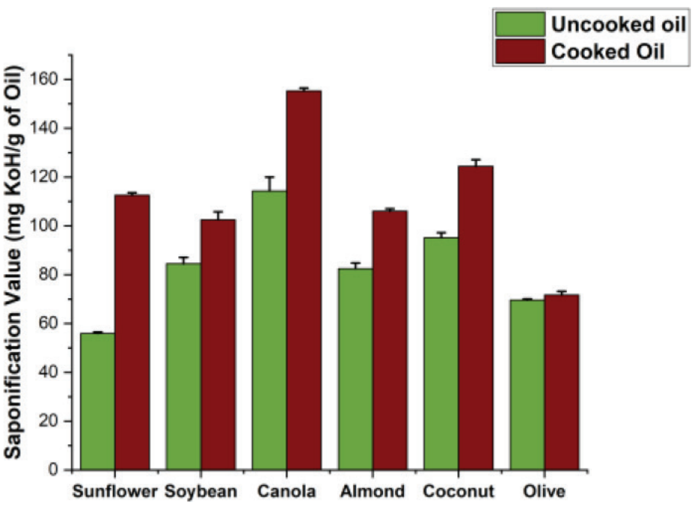

Figure 2: Saponification value of oil samples before and after cooking.

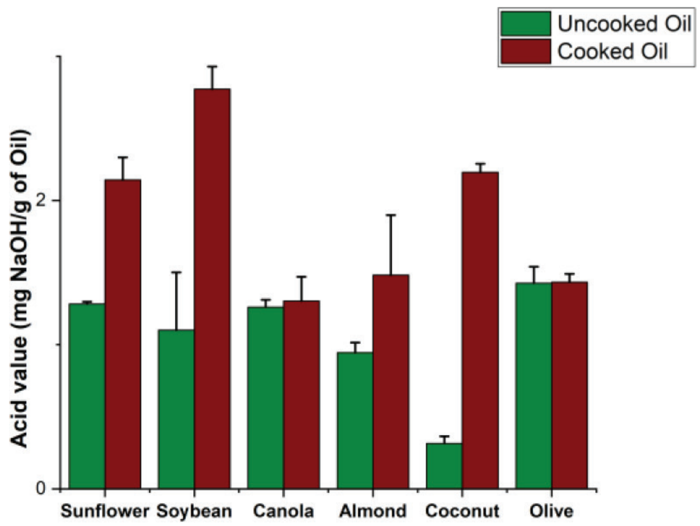

Figure 3: Acid values of oil samples before and after cooking.

observed to be 1.14 and 0.28 for sunflower oil, 2.77 and 1.10 for soybean oil, 2.30 and 2.26 for canola oil, 1.48 and 0.94 for almond oil, 2.19 and 0.31 for coconut oil, for olive oil 6.43 and 6.42 mg NaOH/gm. Acid value of oil samples were increased after cooking in all the oil samples except canola oil and olive oil Figure 3.

DISCUSSION

Vegetable oils extracted from plant sources mainly contain triglycerides and lipids. Several quality parameters like saponification value, acid value, peroxidase value and iodine value will be helpful in estimating the quality of edible vegetable oils. One of the common method of food prepartion is deep frying in oils. The composition of oil changes due to repeated frying procedures.[19] Repeated frying can cause hydrolysis and oxidation of oils which alters the nutitional properties.[20] Frying of oils also cuses a decrease in oxidative stability which leads to instant oxidation of lipids and fats present in oils. Cosuming food prepared by repeated frying procedures can cause severe health problems. Current study was intended to evaluate the quality difference between cooked and uncooked oils. Six different types of edible oils were examined using standard procedure of association of official analytical chemist (AOAC) and American oil chemist society (AOCS).

In each sample, the saponification value was found statistically significant before and after cooking. Saponification value helps in understanding average chain length of free fatty acid which indicates the quality of triglycerides and signify the weight of the oil sample. Repeated heating of oils leads to hydrolysis of triglycerides and increase in free fatty acids in the oil. Repeated heating also decreases the amount of unsatutated fatty acids in the oil eventually decreasing the quality of oil.

Increased acid value may be attributed to temperature effect on triglyceride destruction.[20] We observed almost no chage in acid values of olive oil and conola oil before and after cooking. These acid value was found to be statistically significant in each instance. Domestic usage of oils and fats which contain high value of acidity is harmful to health. This data might be helpful for the regulation of oils used for cooking purposes and determining food safety and quality.

CONCLUSION

The physicochemical properties (acid value and saponification value) were investigated according to FAO/WHO recommendation (AOCS official methods). This investigation has demonstrated that Saponification values of oil from all the handling focuses didn't fulfill the standard guideline; not withstanding, 25% satisfying the Guideline. Widely used sunflower oil had a 2 fold significant increase in saponification value and 5 fold significant increase in acid value after repeated cooking which indicate sunflower oil might not be appropraiate for domestic usage. Taken together, out results indicate that olive oil might be a better choice for domestic cooking as it retained the physicochemical properties after undergoing repeated cooking.

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CONFLICT OF INTEREST

The authors declare no conflict of interests.

ABBREVIATIONS

AOCS: American oil chemist society; **SV:** Saponification value; **AV:** Acid value.

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