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## Extraction and characterization of crude and refined groundnut (*Arachis hypogaea* Linn) oil

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**Abstract**

This study investigated the extraction and characterization of crude and refined groundnut oil. Oil was extracted by Soxhlet method using petroleum ether (60-80) for 8 hours. Refining of oil was done by chemical method. Chemical properties measured during investigation were free fatty acid (FFA), peroxide value (PV), p-Anisidine value (AV), Total oxidation value (TOTOX), Conjugated dienes value (CD), thiobarbituric acid value (TBA), carotenoid, and total tocopherol. The values obtained for crude groundnut oil are FFA (2.8±0.03 % as oleic acid), PV (1.26±0.04 meq/kg), AV (7.52±0.03), TOTOX (10.04±0.01), CD (0.36±0.01 % as dienoic acid), TBA (7.17±0.04 meq/kg), carotenoid (75.6±0.09 mg/kg) and total tocopherol (670±7.5 ppm). On the other hand, chemical characteristics of refined groundnut oil was FFA (1.98±0.01 % as oleic acid), PV (0.92±0.01 meq/kg), AV (4.77±0.04), TOTOX (6.61±0.02), CD (0.21±0.04 % as dienoic acid), TBA (3.09±0.01 meq/kg), carotenoid (34.85 ±0.05 mg/kg) and total tocopherol (219±1.9). From the results it can be seen that groundnut oil has greater potential for domestic and industrial oil.

**Keywords:** Groundnut seed, crude and refined groundnut oil, extraction, characterization and total oxidation value.

**Introduction**

Edible oils from plant sources are used in various food and industrial application. They provide characteristic flavours and textures to foods as integral diet components and can also be used as source of oleo chemicals (Morrison *et al.*, 1995) [12]. Oleo chemicals are completely biodegradable and can be used in place of petrochemicals. Vegetable oils had important contribution to human diet and serving as good source of protein, lipid and fatty acid for repairing of worn- out tissues, formation of new cells and good source of energy (Gaydon *et al.*, 1983) [8].

Groundnut (*Arachis hypogaea* Linn) is a legume crop grown mainly for its edible seeds. It is an annual crop, widely grown in the tropics and subtropics. It is classified as grain, legume and an oil crop because of its high oil content. Groundnuts are rich in essential nutrient and excellent source of vitamins B, C and several dietary minerals such as manganese, magnesium and phosphorous. Groundnut oil is edible oil produced from groundnut seeds. This vegetable oil is also known as Arachis oil and peanut oil (Aluyor *et al.*, 2009) [11]. It contains only small proportion of non-glyceride constituents. It is mild-tasting excellent food oil, with good flavour and high quality because of its low free fatty acid value. The oil can be extracted by mechanical method and using solvent method. Mechanical method which is most common for groundnut extraction include three basic steps: groundnut pretreatment, screw pressing (expelling) and oil clarification (Bernardini, 1973) [5]. The solvent extraction method of oil extraction use hexane or petroleum ether as a solvent. This method include following steps: groundnut pretreatment, oil extraction and solvent recovery from the oil and meal (Bernardini, 1973) [5].

Treatment of crude groundnut oil to produce refined grades involves: degumming to remove easily hydralable phospholipids, neutralization or alkali refining to remove FFA impurities, bleaching (or decolorising) is to reduce the levels of pigments such as carotenoids and chlorophyll and deodorization that removes the volatile components such as aldehydes and ketones, that give rise to undesirable flavours, colours and odours in oil (Carr, 1976) [6].

Groundnut protein is increasingly becoming important as food and feed sources. The seed has several uses as whole seed, peanut butter, oil soups, stews and other products. Groundnut provides considerable amount of minerals for the requirements of human and farm animals

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(Asibuo *et al.*, 2008) [4]. Groundnut seeds are reported to contain 9.5 to 19.0% total carbohydrates as both soluble and insoluble carbohydrate (Woodroof, 1983) [16]. Groundnut is a vegetable protein which is used in natural health care as a source of protein. With increase of fake drugs in developing countries people are encouraged to eat fruits and vegetables. The roasted groundnut is good for health. The groundnut cake is mainly utilized as an animal feed. It serves as a good nutritious food for milk giving animals.

## Materials and Methods

### Sources of materials

The seeds of groundnut were procured from the local market at Hisar (Haryana).

### Extraction of groundnut oil

The seeds of groundnut were ground to powder. Oil was extracted by Soxhlet method using petroleum ether (60-80 °C) for 8 h. Solvent extraction processes include basically three steps: preparation, extraction, and desolventizing.

### Refining of the groundnut oil

Refining of oils was done by chemical method (Carr, 1976) [6] in the following steps: Degumming, neutralization, bleaching and deodorizing.

### Characterization of extracted groundnut oil

Free fatty acid and primary oxidation products-hydroperoxides was determined by peroxide value (PV) according to AOAC (1990) [3] method.

Formation of secondary oxidation products was measured by p-Anisidine Value (AV) according to the AOCS method (1998) [2].

Total oxidation (TOTOX) values was determined using the following equation according to Shahidi and Wanasundara (2008): Total oxidation (TOTOX) values =  $2 \times PV + AV$

Conjugated diene was assessed based on IUPAC method (1987) [9].

Thiobarbituric Acid Value (TBA) was determined according to the method of Johansson and Marcuse, (1973) [11].

Carotenoid content was determined by the method of Vasconcellous *et al.* (1980) [15].

Total tocopherol was determined by the method of Philip *et al.* (1954) [13].

## Results and discussion

The results of chemical characteristics of crude and refined groundnut oil are presented in table 1.

**Table 1:** Chemical characteristics of crude and refined groundnut oil

Parameters	Crude Groundnut oil	Refined Groundnut oil
Free fatty acid (% as oleic acid)	2.8±0.03	1.98±0.01
Peroxide value (meq/kg)	1.26±0.04	0.92±0.01
p-Anisidine Value	7.52±0.03	4.77±0.04
Total oxidation values	10.04±0.01	6.61±0.02
Conjugated dienes (% as dienoid acid)	0.36±0.01	0.21±0.04
T BA Value (meq/kg)	7.17±0.04	3.09±0.01
Carotenoid (mg/kg)	75.6±0.09	34.85±0.05
Total tocopherol (ppm)	670±7.5	219±1.9

Table 1 shows the chemical characteristics of crude and refined groundnut oil. Free fatty acid is an important oil quality indicator during each stage of processing. Free fatty

acid of any lipid is measure of hydrolytic rancidity (Rehab, 2010) [7]. Higher value of FFA of any lipid, higher the degree of hydrolytic rancidity that set-in (Arawande and Amoo, 2009) [10]. The free fatty acid was found to be 2.8±0.03 and 1.98±0.01 (% as oleic acid) for crude and refined oil respectively, which is significantly low. Peroxide value (PV) is a measure of the concentration of peroxides and hydroperoxides formed in the initial stages of lipid oxidation. The hydroperoxides formed from lipid oxidation are decomposed to volatile carbonyl compounds or nonvolatile oxidized dimers, trimers, or polymers by further oxidation. PV is one of the most widely test used for the measurements of oxidative rancidity in oils and fats. PV observed for crude and refined groundnut was 1.26±0.04 and 0.92±0.01 meq/kg. The p-anisidine value is measure of secondary lipid oxidation products, which is 7.52±0.03 and 4.77±0.04 for crude and refined groundnut oil. It is based on the reactivity of the aldehyde carbonyl bond on the p-anisidine amine group, leading to the formation of a Schiff base that absorbs at 350 nm (Ying *et al.*, 2010) [17]. TOTOX value was 10.04±0.01 and 6.61±0.02 for crude and refined oil respectively while CD value were 0.36±0.01 and 0.21±0.04 (% as dienoid acid). During the oxidation process, peroxides are generally decomposed to lower molecular weight compounds. One such compound is malonaldehyde, which is measured by TBA (Thiobarbituric Acid) method. Malonaldehyde, a compound which is used as index of lipid peroxidation, was determined by spectroscopic analysis during course of study. TBA values for crude and refined groundnut were 7.17±0.04 and 3.09±0.01 meq/kg. Carotenoid was found to be 75.6±0.09 and 34.85±0.05 mg/kg for crude and refined groundnut oil. Total tocopherol content present in crude and refined groundnut oil was 670±7.5 and 219±1.9 ppm respectively. Results shows that natural antioxidants present in crude oil were removed during refining process to some extent. This shows that refined oil become more prone to oxidation as compare to crude oil.

## Conclusion

Groundnut oil is high quality edible oil with its low free fatty acid value. Low FFA value is advantageous in term of storage stability and indicates that the oil is edible and can stay for long time without getting rancid. Low PV value observed shows that oil is fresh and can be preserved for long time. The results of this study indicate a significant decrease in carotenoid and total tocopherol contents at the end of chemical refining process. A significant amount of total tocopherol in the crude oil was removed during the refining process. However, suitable amounts of total tocopherol remain present in refined oil to increase the shelf life of oil.

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