



# Physico-chemical Properties and Assessment of Edible Oil Potential of Peanuts Grown in Kurram Agency, Parachinar

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Received 06 November 2014, Revised 16 March 2015, Accepted 17 May 2015

## Abstract

This study was carried out to investigate the oil potential of peanuts for domestic and commercial uses. Peanut oil yield and the physico-chemical properties of extracted oil were investigated on different temperatures (50, 55, 60 and 65 °C) and sun drying. Results showed maximum oil yield of 47.2 % at sun drying and lowest values of 37.0 % at 65 °C. Highest and lowest acid values are 25.52 and 5.89 mg/KOH/g at 60 °C and 50 °C respectively. The Free Fatty Acid (FFA) content were obtained 12.76 and 2.94 mg/g at 60 °C and 50 °C, while saponification values were 61.71 and 32.25 mg/KOH/g at 60 °C and 50 °C respectively. The highest Peroxide value of 92 mg/KOH/g was recorded at 55 °C which dropped to 43.4 mg/KOH/g at 65 °C. Refractive index (RI) and density were not changed significantly ( $p \leq 0.05$ ) on all temperatures, while pH was somewhat higher on 50 °C. The moisture content was found lowest up to 3.0 % on 65 °C while highest was 5 % on 50 °C.

**Keywords:** Oil Density; Oil yield; Peanuts oil extraction; Refractive index; Saponification; Soxhlet Extractor

## Introduction

Agricultural products are classified into oil-seeds (cotton, castor, sunflower, etc), nuts (coconut, groundnut, chestnut, etc) and mesocarps or fruits (oil palm). Plants bearing these agricultural products have greatly contributed to the economic development of many countries especially the development of West African countries where the products are grown for commercial purposes. Among them many types of oils can be obtained from these products, only few are very significant in terms of world production and export as major commodities [1]. However, the oil extracted from these products has diverse domestic and industrial uses. The oil serves as a major source of vegetable oils that constitutes a

good percentage of meal in the diets of aged people. The oils as well as their by-products are also very useful as food and non-food materials for the production of snacks, cake, margarine, biscuit, cosmetics, detergent, plastics, etc [2].

Peanut is presently cultivated on about 42 million acres globally. After soybean and cotton, peanut is the third major oily seed crops of the world. There has been a steady growth in the demand of edible oil both for domestic and commercial uses [3].

According to Hussain et al. [4] oil productivity in Pakistan is poor to meet the demands. About one third is imported which is 5

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% of the total import. The present investment is of Rs 384 billion (\$ 4.5 billion). According to Mehdi et al. [5] annual increase in edible oil consumption is about 7.7 % due to population growth and increase in per capita income, which is important food stuff.

It has been estimated that production-consumption margin is increasing by thousand tons because of population growth and rise in per capital income. This situation requires a serious consideration for effective future planning of maximizing oil seeds production in the country [6]. Undoubtedly, such a measure is the crying demand of the country from the agricultural sector. Samuel [7] reported that the Federal government has, for the first time, recognized the need to reduce the dependence on importation of edible oil, and to develop and sustain price stabilization mechanism for the oil seeds in the country. Good quality edible oil is fresh, free from odious and any trace of rancidity. The acceptability of the products at world edible oil market depends on its ability to satisfy basic standard tests for fats, cholesterol and oils [8].

Peanuts mainly consists of protein 22–30 % and oils 44–56 % providing high energy source of 5.64 cal/g [9, 10]. Peanut oil mainly composed of unsaturated fatty acids and is consequently susceptible to lipid oxidation [11]. The ratio of polyunsaturated fatty acids to saturated fatty acids of peanuts has been reported as 1.8 compared to 2.9 for soybean oil, 4.3 for corn oil and 8.7 for sunflower oil [12]. Peanut oil principally contains less linoleic acid (a relatively unstable fatty acid) than other seed oils. Oleic, linoleic, and palmitic acids account for calcium. A total 90 % of the fatty acid profile of peanuts, although five other fatty acids are present in at least 1 % proportions [11].

There it is necessary to find out alternative source of oils to complement the existing oil in order to meet both domestic and commercial demands. Crops (peanuts) are re-planting every season and can be harvested easily without posing any risk.

Peanuts are one of the most important crops species in Pakistan. Besides, the intrinsic

interest in the ecological aspect, this crop has been widely cultivated in Pakistan. Peanuts are mostly planted in sandy region of Pakistan for their domestic's uses and commercial purposes. Peanuts could be cultivated over a large area of land and during production, it produces very well. There is thus a great potential of production of peanuts and invariably its oils and other commercial uses. However, there is need to extract oil from the seeds of peanut, because this will assist in augmenting the quality and shortfall in production caused by already existing oils. The objective of this work is to investigate the potential of oil from peanuts grown in the sandy region of Pakistan for commercial uses.

## Materials and Methods

### *Materials collection and preparation*

The seeds used for the study were obtained from the Kurram Agency, Parachinar. The fresh peanuts were handpicked from the cultivated plants and some were obtained by breaking the matured pods. They were initially sun dried because most of the seeds were still fresh. After sun drying, the nuts were sorted out by removing decayed/ defective and immature seeds to ensure the quality of extracted oil. Thousand grams (1000 g) of the sorted peanuts were divided into five parts of 200 g each. These were later manually shelled to obtain the seeds.

### *Experimental procedure*

One of the portions of the shelled seeds were sun dried for 24 hours, while the others four parts were oven dried at different temperatures i.e., 50, 55, 60 and 65 °C for five hours. The five samples were then milled to powder form using electric blender to allow easy oil extraction [13]. Solvent extraction method was used to extract oil from milled peanuts using Soxhlet Extractor (Cavalier model).

About 100 g of the milled sample was wrapped with filter paper. This was inserted into the condenser of the extractor. The round bottom flask was filled with the solvent (n-hexane) up to two-third capacity of the flask. The reflux condenser was filled to the top of the extractor and water flow was turned on.

The round bottom flask was placed in the thermo mantle and temperature of the thermo mantle was adjusted to 50 °C [26], so that the solvent is brought to the evaporation point. Each extraction occurred over a period of 8 hours. When the solvent has just drain off over the barrel, the condenser was detached and the thimble removed. The filtrate was kept in desiccators and allowed to cool at room temperature. The residue solvent was allowed to evaporate. These procedures were repeated for each of the five samples (sun dried sample, 50, 55, 60 and 65 °C). The extracted oil was re-heated to remove the n-hexane from the oil through evaporation.

### *Proximate analysis*

In evaluating the oil potential of the extracted oil, the refractive index, density, saponification value, Acid value, Free Fatty Acid (FFA), moisture content, peroxide value and oil yield were determined using standard method as suggested by Association of Official Analytical Chemical (AOAC, 2012) [14].

### *Refractive index*

Refractive index, also called index of refraction, is a measure of the bending of a ray of light when passing from one medium into another. It can also be defined as a dimensionless, number that describes how light or any other radiation propagates through the medium. In this research work, the refractive index was determined using the refractometer (Erma hand refractometer) as suggested by Ayo and Agu [15]. It has range of 0-32 %. A drop of the oil was placed on the surface of the refractometer and the reading was taken.

### *Saponification value*

Saponification value of an oil or fat is the number of potassium hydroxide required to neutralize the fatty acid resulting from the complete hydrolysis of 1 g of the sample [15]. In determining the saponification value of the acid, 2 g of oil or fat was weighed into a flask. Twenty five (25) ml alcoholic potassium hydroxide solution was poured into the conical flask containing the oil, and it was attached to reflux condenser. This was heated through boiling water

bath for 1 hour with random shaking. After one hour, 1 ml of the phenolphthalein solution was added and titrated with the standard hydrochloric acid. This procedure was repeated for each of the five samples. Then the blank (that is potassium hydroxide solution without oil) was titrated using the same procedure. The saponification value was then determined through equation 1.

$$\text{Saponification Valu} = (b - a) \frac{28.05}{w} \quad (1)$$

Where as “a” is titrate of sample, “b” is titrate of the blank and “w” is the weight of sample.

### *Acid value*

The acid value of an oil/fat is the number of potassium hydroxide required to neutralize the free acids resulting from the complete hydrolysis of 1g of the sample [15]. In determining the acid value, 25 ml diethyl ether with 25 ml ethanol was mixed and 1.0 ml of 1.0 % phenolphthalein solution was neutralized and was titrated with 0.1 ml sodium hydroxide solution then 1-10 g of the oil in the neutralized solvent mixture was dissolved and titrated with 0.1 ml sodium hydroxide solution. The acid value was therefore determined using equation 2.

$$\text{Acid value} = \text{Titration (ml)} \times \frac{5.61}{\text{weight}} \quad (2)$$

### *Peroxide value*

The concentration of peroxides in oil gives an indication of the extent of spoilage. The oil was treated with potassium iodide in an organic solvent. The peroxide liberated the iodine from potassium iodine. The iodine was titrated with standard thiosulfate [15].

In determining the peroxide value of the acid, the test was carried out in subdued daylight and 1 g of oil was weighed into a clean dry boiling tube, 1 g of powdered potassium iodide and 20 ml solvent mixture was added to the oil that was inside the boiling tube. Then, it was placed in a boiling water bat for about 60 seconds. After which the contents of water was poured into

it and the washing was added to the titration flask containing 20 ml potassium iodide solution. The tube to be used was washed twice with 25 ml portion of water and the washings were added to the titration flask. Finally it was titrated with 0.002 ml thiosulfate, using starch as indicator. The peroxides value was therefore determined using equation 3.

$$\text{Peroxide} = \frac{2(a - b)}{w} \quad (3)$$

Where as “a” is titrate value for the sample, “b” titrate value for the blank and “w” weight of sample.

### Moisture contents

Moisture contents are the quantity of water contained in a material. This is based on loss on drying at an oven temperature of 105 °C. Besides water, the loss will also include the other volatile substances at 105 °C [16].

In determining the moisture content of oils, a clean flat dish of silica platinum was dried, the cool dish was weighed and 5 g of the oil was introduced into the dish. The dish and its contents are transferred into an air oven at 105 °C to dry for about 3 hours. Then a pair of tongs was used to transfer the dish into desiccators, allowing it to cool down in the desiccators for about half an hour. This process was repeated for each of the

five samples and was determined through equation 4.

$$A-B/A * 100 \quad (4)$$

Where “A” is weight of the fresh seeds, “B” is the weight of dried residue.

### Results and Discussion

The results obtained from the study are presented in Tables 1 and 2. Table 1 shows the values of the oil properties observed from the extracted oil from peanuts at different levels of drying temperature. The comparison of the extracted oil with other seed oil is presented in Table 2.

### Oil yield

Table 1 shows that the oil yield from peanuts is significantly ( $p \leq 0.05$ ) high (47.2 %) at sun drying temperature. It decreased to 39.4 % and 37.0 % at 60 °C and 65 °C drying temperature respectively. Comparing these values with other oily seeds (Table 2) showed that the oil contents of the peanuts is higher than sunflower (30.5 %), Soybean (21.0 %), corn (4.5 %) and cotton seed (22.9 %) as reported by Esuoso and Odetokun [17]. This shows that peanuts can as well produce similar quantity like Soybean and cotton seed oil. It also indicates that processing of peanuts oil for industrial or edible purpose would be economical.

**Table 1.** Physicochemical properties of extracted oil from peanuts at different temperatures.

Physicochemical Properties	Sun Dried	Drying temperature levels			
		50°C	55°C	60°C	65°C
Oil yield (%)	47.2±2.37 <sup>c</sup>	41.7±2.11 <sup>ba</sup>	41.9±2.04 <sup>b</sup>	39.4±1.97 <sup>a</sup>	37.0±1.68 <sup>a</sup>
Acid Value (mg/KOH/g)	9.81±0.78 <sup>b</sup>	5.89±0.34 <sup>a</sup>	17.95±1.05 <sup>d</sup>	25.52±1.58 <sup>e</sup>	13.74±1.0 <sup>c</sup>
Free Fatty Acid (%)	4.90±0.41 <sup>b</sup>	2.94±0.18 <sup>a</sup>	8.97±0.97 <sup>d</sup>	12.76±1.71 <sup>e</sup>	6.87±0.61 <sup>c</sup>
Saponification Value (mg/KOH/g)	46.28±4.53 <sup>b</sup>	32.25±2.1 <sup>a</sup>	50.49±4.87 <sup>b</sup>	61.71±5.26 <sup>c</sup>	57.50±5.08 <sup>c</sup>
Peroxide Value (mg/KOH/g)	44.4±2.59 <sup>a</sup>	83.4±6.17 <sup>b</sup>	92±6.96 <sup>c</sup>	46.4±3.11 <sup>a</sup>	43.4±2.54 <sup>a</sup>
Refractive Value	1.463±0.08 <sup>a</sup>	1.462±0.07 <sup>a</sup>	1.461±0.07 <sup>a</sup>	1.461±0.06 <sup>a</sup>	1.460±0.05 <sup>a</sup>
pH level	4.9±0.14 <sup>a</sup>	5.3±0.18 <sup>b</sup>	5.0±0.17 <sup>a</sup>	4.8±0.12 <sup>a</sup>	5.0±0.16 <sup>a</sup>
Moisture Content (%)	2.5±0.08 <sup>a</sup>	4.5±0.10 <sup>c</sup>	5.0±0.11 <sup>d</sup>	5.0±0.10 <sup>d</sup>	3.0±0.1 <sup>b</sup>
Density (Kg/m <sup>3</sup> )	1.14±0.04 <sup>a</sup>	1.14±0.02 <sup>a</sup>	1.15±0.02 <sup>a</sup>	1.13±0.02 <sup>a</sup>	1.15±0.03 <sup>a</sup>

\*All values are mean and standard deviation of 5 samples \*Different letters (a-e) are significantly different ( $p \leq 0.05$ )

Table 2. Physicochemical comparison of peanuts oil with other common seeds oil.

Physicochemical Properties	Experimental peanuts oil					Some other common seed oils									
	Sun dried sample	50 °C	55 °C	60 °C	65 °C	Chestnuts	Sunflower	Soya bean	Corn oil	Melon	Cotton seed	Avocado	Africa oil bean	Cucumeropsis	Andenopus Breviflorus
Oil yield	47.2	41.7	41.9	39.4	37.0	40.9	30.5	21.0	4.5	NA	22.9	NA	NA	NA	NA
Acid value (mg/KOH/g)	9.81	5.89	17.95	25.52	13.74	5.99	0.8	1.0	3.0	4.76	1.4	0.805	1.65	1.20	0.65
Free fatty acid (%)	4.9	2.94	8.97	12.76	6.87	3.01	0.4	0.5	1.5	2.38	0.7	0.37	0.79	0.35	0.40
Saponification value (mg/KOH/g)	46.3	32.3	50.5	61.7	57.5	193.2	191.0	193.0	190.6	197.6	195.0	246.7	185.1	185.6	192.8
Peroxide value	44.4	83.4	92.0	46.4	43.4	1.50	NA	NA	NA	NA	NA	NA	1.57	2.85	NA
Refractive Index	1.463	1.462	1.461	1.461	1.460	1.449	1.475	1.473	1.467	1.478	1.470	1.462	1.465	1.462	1.462
pH Level	4.9	5.3	5.0	5.3	5.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Moisture Content (%)	2.5	4.5	5.0	5.0	3.0	5.80	NA	NA	NA	NA	NA	NA	NA	NA	NA
Esuoso & Odetokun 1995 [17]															

\*NA: value not available

### Acid value and free fatty acid

Free fatty acids can stimulate oxidative deterioration of oils by enzymatic and or chemical oxidation to form off flavor components. Free fatty acid value is an indication of lipase activity [18]. Fatty acid (%) has been calculated based on the molecular weight of the dominant acid. Free fatty acid indicates the possible hydrolytic degradation of the oil and the acid value is employed to ascertain the quality (condition) and edibility of the oils. Free fatty acid from peanuts has it's significantly ( $p \leq 0.05$ ) highest value (12.76 %) at drying temperature of 60 °C. A further increase in temperature resulted in a decrease in FFA. Comparing these values with other seeds oil (Table 2), the free fatty acid from peanuts is higher than soybean (0.5 %), *Cucumeropsis Edulis* (white melon seed) (0.35 %), melon (2.38 %), Avocado (0.37 %), African bean (0.79 %), corn (1.5 %), cotton seed (0.7 %). The values of free fatty acid obtained are high at 55, 60 and 65 °C drying temperature but lower at sun dried and 50 °C temperature. The implication of this is that, peanuts oil having lower value of free fatty acid is potentially edible while those higher values need to

undergo refining to make it suitable for edible and industrial purposes. Free fatty acid is also related to smoke point. Peanuts with low free fatty acid value will have a high smoke point, so it would be suitable for stir fry cooking [19].

### Saponification value

Saponification value of peanuts oil (Table 1) was found highest ( $p \leq 0.05$ ) 61.71 mg/KOH/g at the drying temperature of 60 °C and lowest 32.25 mg/KOH/g at 50 °C. In Table 2, the saponification value from peanuts is lower than soybean 193.0 mg/KOH/g, chestnuts 193.20 mg/KOH/g, melon 197.57 mg/KOH/g, avocado 246.70 mg/KOH/g, African bean oil 185.08 mg/KOH/g, Corn 190.6 mg/KOH/g, Cotton seed 195.0 mg/KOH/g. A saponification value of 200 mg/KOH/g indicates high proportion of fatty acids of low molecular weight and chain length. This shows that the oil may not have a potential for use in soap making and in cosmetics industries and or in the thermal stabilization of poly vinyl chloride (PVC). This property makes them useful as sources of essential fatty acids required in the body [20].

### Peroxide value

Peroxide value is an index of rancidity, thus the high peroxide value of oil indicates a poor resistance of the oil to peroxidation during storage and it indicate the level of deterioration [13, 21]. The peroxide value of peanuts oil has significantly ( $p \leq 0.05$ ) highest value of 92 mg/KOH/g at a drying temperature of 55 °C while found lowest at 65 °C (43.4 mg/KOH/g) and on sun drying temperature (44.4 mg/KOH/g). The peroxide value of peanuts is higher than *Cucumeropsis Edulis* (white seed melon) 2.85 mg/KOH/g, African oil bean 1.57 mg/KOH/g, as reported by Adebayo et al. [13]. This is also higher than maximum acceptable value of 10 mg/KOH/g set by the Codex Alimentarius Commission [22] for such oils as chestnut seed oils.

### Refractive index

The recorded refractive index (RI) of peanut oil at different temperature were not significantly ( $p \leq 0.05$ ) varied. The values of RI obtained from peanuts oils are similar to those of chestnut 1.449 %, sunflower 1.4750 %, soybean 1.4730 %, *Cucumeropsis Edulis* (white seed melon) 1.4622 %, melon 1.4680 % and cotton seed 1.4700 %. The higher values of the properties obtained for the crude oils revealed the necessity to purify the oils. The high refractive index of oil also showed that the fatty acids in the oil will contain a high number of carbon atoms [23].

### pH level

The pH value of the extracted peanuts oil (Table 1) found in the range of 4.9 to 5.3 at different temperatures. However it was not a significant ( $p \leq 0.05$ ) variation.

### Moisture contents

The moisture contents obtained from the current study has significance ( $p \leq 0.05$ ). The highest possible value of 5.0 % was found at 55 and 60 °C, and the least value of 2.5 % at sun drying temperature (Table 1). The moisture level of peanut oil was lower than the chestnut 5.8 % reported by Esuoso and Odetokun [17] (1995).

Lower moisture content implies good shelf life characteristics of oil [25].

### Density

The density of the oil obtained from peanuts range between 1.13 to 1.15 Kg/m<sup>3</sup> (Table 1) though there was no significance variation ( $p \leq 0.05$ ) at all applied temperatures. The density of peanuts oil lower than water and the differences between oil are quite small, particularly amongst the common vegetable oils.

### Conclusions

Peanuts oil has the highest oil yield of 47.2 % by complying with other crops oil yields. Beside this other properties such as highest acid value of 25.52 mg/KOH/g, highest Free Fatty Acid (FFA) of 12.76 %, highest saponification value of 61.7 mg/KOH/g, highest peroxide value of 92.0 mg/KOH/g and moisture content of 5.0 % was found appropriate. The color and odor is similar to other common oils such as sun flower and soybean and attractive for cooking. Therefore it is suggested; that the oil of peanuts has more edible potential than the other oils for domestic and commercial purposes.

### Acknowledgements

The author is highly grateful to National Centre of Excellence in Geology, University of Peshawar and Food and Marine Resources Research Center, PCSIR Laboratories Complex Karachi, Sindh, Pakistan for their hearted support in chemical analysis.

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