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Comparative Study of Fatty Acid Composition and Characterization of Fixed Oil of Four Peanut Varieties Available in Pakistan

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Abstract – four varieties of ground nut (*Arachis hypogea*) were collected from different areas of Pakistan (Tillagang, Gujar khan, Hanoi and Pipplan) from Punjab province .The oils were extracted for the evaluation of lipid .Physico-chemical values of oils were determined like refractive index, peroxide value, unsaponifiable matter, acid value, iodine value, free fatty acid and ester value. The lipid profile as indicated by GLC showed that Palmitic acid ranged from 8.2-8.8%, proportions of oleic acid and linoleic acid varied from 57.8-59.87% and 22.5-24.1% respectively. Gujar khan variety of peanut has higher % age of oil (56.79). The higher yield of oil in this variety is not at the cost of any nutritional quality of peanut oil.
Keywords – Lipid composition, *Arachis hypogea*, yield, Fatty acids

Introduction

Arachis hypogea (peanut) belongs to the family Leguminosae (Duke, 1981). Leguminosae is the most important family in the Dicotyledonae (Harborne, 1994). Arachis hypogea is the second largest oilseed crop after rape/ mustard seeds in the country. The nut is normally composed of 25-35% shell and 65-70% kernel that in turn contain 45-55% oil and 25-30% protein (Din *et al.*, 1999). Oil derived from peanut is pale gold and subtly flavored with the richness of peanut and used in cooking and in the preparation of shortening, margarines and mayonnaise. It is also used as salad oil and the meal is used as food and also for feed purpose (Thrope, 1947; Swern, 1979; Eckey, 1954). Peanut oil has health promoting chemistry. It has more than 80 percent oleic fatty acid therefore affects HDL and LDL ratios positively, reduces platelet stickness, increases circulation, reduces blood pressure, slowers cholesterol production, prevents inflammation, reduces joint tenderness, stimulate the immune system,assists the balancing of hormones especially as related to PMS and menopause moreover can lower blood pressure and alleviate other cardiovascular disorders.

Due to the importance of the oil of peanut better planning and efforts are needed for increasing the production of groundnut by introducing high yielding and high quality varities. The groundnut crop has not yet considered for increasing the potential of edible oil in Pakistan. Edible oil shortage is one of the chronic problems in Pakistan for the past three decades and consequently imports have been increasing to meet the local market demands. The import of edible oil during the years 1996-97 and 1997-98 was about 1.2 and 1.3 million tons at a heavy cost of foreign exchange equivalent to Rs 23.4 and 32.2 billon respectively. The local production of edible oils in Pakistan has not increased beyond 400,000 tons against a demand of about 1.8 million tons per annum. Therefore, it is essential to increase the local oil production by utilizing all available agricultural resources including the groundnut. Four peanut varieties cultivated in Gujar Khan, Pipplan, Hanoi, and Tillagang have now been studied to evaluate their oil quality and yieldbecause all the four varieties of peanuts have different sizes of shells and seeds This approach, can help in increasing the production of peanut oil in the country. Specific techniques have been used for extraction of oils; their purification, identification and their characterization. The oils were hydrolyzed, methylated and the fatty acid composition of these oils were determined by means of GLC.

Experimental

Extraction of oil-The seeds of peanuts of four varieties were procured from four different areas of Pakistan like Gujar Khan, Pipplan, Hanoi and Tillagang. The seeds

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were dried in oven at 105°C and crushed into fine powder. The lipids were extracted with 500 ml chloroform: methanol (2 : 1v/v) (Waheed *et al.*, 1980) mixture at room temperature by shaking on magnetic stirrer for 2 hours. After filtration the residual material was treated three times with 100 ml of the same mixture. All the extracts were combined and three consecutive washings with Folch solution (Folch *et al.*, 1957) were given to remove the non-lipid impurities. After removal of solvent under reduced pressure, the oils were stored in an inert atmosphere.

Physicochemical values of the oil – The physico-chemical values like saponification value, iodine value, estervalue, free fattyacid were determined according to British standard specification and (British Standard Specification 1958) procedure. Refractive index was determined by Abbe's refrectometer.

The oil was refluxed with 0.5 N alcoholic potassium hydroxide solution for 3 hours. The soap solution reacted with 2 N H_2SO_4 to liberate fatty acids after seperation of unsaponifibale matter by diethyl ether (Raie *et al.*, 1980). The methyl ester of fatty acids was prepared with BF_3-Methanol reagent (William *et al.*, 1964).

Separation of lipid classes from oil – The lipids classes were fractionated quantitatively by thin layer chromatography. Known weight of lipid (10% solution in chloroform) was applied on plate 3 cm above the lower edge of the plate coated with 0.5 mm silica gel. The developing media (Raie *et al.*, 1995) for neutral and polar lipids were hexane: diethylether: aceticacid (80 : 20 : 2 v/v) and chloroform: methanol; 30% ammonium hydroxide: water (60 : 35 : 5 : 2.5 v/v). The developing bands were identified by comparing their R_f values with standards and also by applying their specific color tests.

Identification of fatty acids by GLC – The methyl ester of lipid fractions were analyzed on Shimadzu GC-4A gas chromatograph equipped with flame ionization detector and polar (PEG) capillary column (25 mx 0.2 mm i.d). The temperature programming of column oven was 180°C-3°C/min-220°C. Nitrogen was used as carrier gas with a flow rate of 2 ml/min. The temperature of injector and detector was 230°C and 250°C respectively. The peaks were recorded on Shimadzu CR-4A chromatopac and identified by comparing their retention time with those of standards run under the same parameters.

Results and Discussion

By using methanol and chloroform mixture the oils of the peanut varieties were extracted. The solvent was then removed at reduce pressure to avoid changes like polymerization and decomposition of oils. The yield (%) of four varieties is given in Table 1. All the varieties showed almost the same range of yield as indicated in earlier studies (Swern, 1979) except the Gujar Khan variety (56.79%). Gujar khan and Tillagang varieties showed high % age yield of oil and this is may be due to the low temperate climate and minerals rich soils of these areas. Hanoi variety has minimum oil % age (38.42%). The lower yield of oil from seeds of Hanoi and Pipplan varieties of peanut was probably due to heat effect because of the sandy soil and hot dry climatic condition of these areas.

Chemical constituents are valuable to evaluate oils with respect to its utilization. Some important physico chemical properties of *Arachis hypogae* oils of all four varieties determined to evaluate the quality of the oil which are given in Table 2. Oils can be classified on the basis of iodine value .The iodine value of all the varieties were 95.76, 95.68, 101.38, 98.73 for which the oil is considered to be semi drying. Gujar khan variety peanut is highly monounsaturated and considered to be high oleic acid oil. The saponification values 187.32 of Hanoi, 186.23 of Pipplan, 212.11 of Gujar Khan and 186.67 of Tillagang show the presence of fatty acids having high molecular weight. Low free fatty acids present in the oil of all peanut varieties indicate that the oils of all varieties are fit for human consumption. The reading of refractive index of all the varieties are slightly different from each other its mean density, molecular weight and internal arrangement of fatty acids related to refractive index are slightly different from each other and this is due to cultivation of crops in different regions of country have slightly different climatic conditions. Slightly high peroxide values of the oils indicated formation of epoxides. These

Table 1. % age of oils of four varieties of peanut

Sr.#	Sample	Solvent used in extraction	Weight of peanuts in gm	Yield of oil in grams	% Yield of oil
1	Peanut oil of Pipplan variety	Chloroform:Methanol	59.018 g	23.503 g	39.83%
2	peanut oil of Hanoi variety	Chloroform:Methanol	55.62 g	21.62 g	38.42%
3	peanut oil of Gujar khan variety	Chloroform:Methanol	32.8278 g	18.6457 g	56.79%
4	peanut oil of Tillagang variety	Chloroform:Methanol	46.899 g	20.556 g	43.83%

Table 2. Physico-chemical values of lipids of four varieties of peanut

Sr.#	Physico Chemical property	peanut oil of Hanoi variety	peanut oil of Pipplan variety	Peanut oil of Gujar Khan variety	peanut oil of Tillagang variety
1	Refractive index	1.4633	1.4631	1.4637	1.4635
2	Peroxide valve	3.74	10.13	6.49	5.60
3	Iodine value	95.68	95.76	98.73	101.38
4	Saponification value	187.32	186.239	212.11	186.67
5	Unsaponifiable matter	0.018	0.08	0.318	0.204
6	Acid value	0.3462	0.55	0.45	0.52
7	Free fatty acid	0.174	0.275	0.227	0.262
8	Ester value	186.97	185.68	211.66	186.15

Table 3. Fatty acid profile of four varieties of peanut

Sr.no	Name of fatty acid	Short hand name	Peanut oil of Hanoi	Peanut oil of Pipplan	Peanut oil of Gujar khan	Peanut oil of Tillagang
1	Capric acid	$C_{10:0}$	T	T	0.09	T
2	Lauric acid	$C_{12:0}$	T	0.05	0.02	0.2
3	Myristic acid	$C_{14:0}$	T	0.03	0.02	0.2
4	Palmitic acid	$C_{16:0}$	8.2	8.43	8.20	8.82
5	Palmitolic acid	$C_{16:1}$	T	T	T	T
6	Stearic acid	$C_{18:o}$	03.9	4.3	2.5	3.7
7	Oleic acid	$C_{18:1}$	59.87	57.8	58.7	59.1
8	Linoleic acid	$C_{18:2}$	22.9	22.5	24.1	22.7
9	Linolenic acid	$C_{18:3}$	1.3	1.38	1.43	1.48
10	Arachidic acid&higher	$C_{20+higer}$	3.7	4.8	3.9	3.6

high values are due to the reason that oils are in crude form. The oil of this range of peroxide value even in crude form is considered to be fit for edible purpose.

The other physicochemical values of the four varieties are more or less same with only slight variation in them. The variation may be due to different climatic condition and soil properties. The pattern of variation is more or less similar as indicated in earlier studies (Koman *et al.*, 1976; Savage *et al.*, 1998; Eheart *et al.*, 1955).

The fatty acid profile of the peanuts oil of all varieties (Table 3) show higher percentage of unsaturated fatty acid as compared to saturated fatty acids which is according to the earlier investigation (Anderson *et al.*, 1967). Among saturated fatty acid Palmitic acid $C_{16:0}$ present in high concentration among all the varieties. Stearic acid $C_{18:0}$ also present but not in huge amount. Arachidic acid present in very low concentration in all the four peanut varieties and the characteristic of this oil. High % age of unsaturated acid is the characteristic of vegetable oil. Oleic acid is the major fatty acid in all the four varieties of peanut, this high concentration of $C_{18:1}$ is very useful for human because it lower HDL, which decreases CVD risk (Spiller 1991).

Table 4. Yields of neutral and polar lipids of four varieties of peanut

Varieties	Neutral lipids	Polar lipids
Tillagang	93.8%	6.2%
Gujar khan	94.2%	5.8%
Hanoi	96.3%	3.7%
Pipplan	96.8%	3.2%

Table 4 showed more than 90% yield of neutral lipids and lesser concentration of polar lipids in all peanut varieties. Similarly both neutral and polar lipids of all the four varieties exhibited very high concentration of oleic acid. Proportions of fatty acids of polar and neutral lipids of all the four cultivars are shown in Table-5.

Over all the present study indicates that Gujar Khan variety produces significantly higher yield of peanut oil, which also contained higher % age of linoleic acid. This is may be due to the reason that vegetable oils from low temperate region contained more oil contained high linoleic acid as compared to other regions. It is noteworthy that

Table 5. Proportions of fatty acids in neutral and polar lipids of four varieties of peanut

Varieties	Proportions of fatty acids				
	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
	Neutral Lipids				
Tillagang	9.6	3.4	60.3	21.5	1.6
Hanoi	9.3	4.1	59.94	23.4	1.47
Pipplan	8.8	4.6	58.37	20.93	1.05
Gujar khan	8.75	2.73	59.08	25.3	1.7
	Polar Lipids				
Tillagang	15.7	3.08	57.4	20.03	2.1
Hanoi	14.6	4.5	57.09	22.7	1.8
Pipplan	9.1	3.9	59.79	23.8	1.84
Gujar khan	10.8	4.75	60.8	19.9	1.73

the higher yield obtained in Gujar Khan variety is not at the cost of other positive values linked to peanut qualities. It is therefore imperative that Gujar Khan variety of peanut be promoted by the Agricultural Department to enhance the availability of edible oil in the country.

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