IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 6 Issue 8, August 2019
ISSN (Online) 2348 – 7968
www.ijiset.com

Assessment of Physico-chemical Characteristics of extracted oil of different groundnut varieties grown in India

Dr.Shashikant Pardeshi*

Abstract: In the present study five different groundnut varieties such as Rajasthan Nagori RD 1:10(RRD1:10), G10 Gujarat(G10G), Shivpuri(Sv), Rajasthan Gugeri (Rg) and Tag(Tg) were grown under different geographical places in India. Oil yield and physicochemical characteristics of collected groundnut seeds and their extracted oils were determined for their nutritional assay. It was found that the seeds contained in the range of extracted oil, specific gravity, viscosities, impurities and refractive index of the extracted groundnut seed oil and colour were in the range of 40.81-44.95%, 0.9148-0.9160, 91.56-91.76, 0.03-0.06 and 1.4625-1.4634 respectively. AV (mg KOH/g oil), IV (g I_2/100 g oil), SV (mg KOH/ g oil),ester value and unsaponifiable matter content (%) of the extracted oil from groundnut seeds were in the range of 1.18-4.28, 85.75-91.84,188.88-193.23, 186.91-192.1 and 0.5-0.68 respectively. This study is empirical and on the basis of finding it is revealed that groundnut seed oil can be a valuable source of edible oil.

Keywords: Groundnut seeds, Extraction, Physico-Chemical Characteristics

* Scientific Officer, DPHL, Jalgaon, Maharashtra, Email:sjpardeshi@gmail.com

1. Introduction

Groundnut is sixth most important oilseed crop in the world. It contains 48-50% oil and 26-28% protein, and is a rich source of dietary fibre, minerals and vitamins. Groundnut is grown on 26.4% million metric worldwide with a total population of 37.1 million metric t and an average productivity of 1.4 metric t/ha [**10**]. India is the largest producer of groundnut in the world. Around 88% of the groundnut area and production in India is concentrated in five states: Andhra Pradesh, Gujarat, Karnataka, Tamil Nadu, and Maharashtra. Nearly 83% of the total area is under rainy-season groundnut and the other 17% is cultivated during the post rainy season. During 1995-98, groundnut was grown in India over 7.47 Mha with a total production of 8.02 Mt [**8**]**.**India possesses varying climatic conditions results in cultivation of a wide range oil bearing crops trees and nuts. Groundnut /peanut (Arachis hypogaea) is a legume which is widely grown as a food crop. The genus Arachis, a member of the family Leguminoseae, is among the major oil seeds in the world. China, India and USA are the main producers of groundnuts to the rest of the world [7]**.**

The pea nut, often called as “The King of Oilseeds”,is botanically known as *Arachis hypopgaea* and belongs to family Leguminosae, which is also called Fabacae. The pea nuts differ in the quantity as well the quality of oil. These differences in the pea nut oil may be due to several factors *i.e*. genotype, the level of maturity of the seed, season and geographical area of production **[6].** About 80% of the total fatty acid content of pea nut oil constitutes unsaturated fatty acids mainly oleic acid and linoleic acid **[4].** Thus the chemistry and quality of pea nut oil mostly depend on the oleic to linoleic ratio. The studies by **Millar *et al*., (1987)** observed that

the oil containing high UFAs/SFAs ratios are thermodynamically more stable and may be heated to high temperatures **[12]**.

Peanuts make an important contribution to the diet in many countries. Peanut seeds are a good source of protein, lipid and fatty acids for human nutrition [**11**]**.** The oil content of groundnut differs in quantity, the relative proportion of fatty acids, geographical location, seasons and growing conditions [**2**]**.** The fat content in groundnut has been largely studied. In general, Groundnut seed contain 44-56% oil and 22-30% protein on a dry seed basis and is a rich source of minerals such as phosphorus, calcium, magnesium and potassium and vitamins like E, K and B group **[14]. Barku et al.(2012)** have reported changes on the chemical composition as a result of processing. However, little information on the effect of traditional processing on peanuts quality was reported. The chemical properties of oils are amongst the most important properties that determine the quality and help to describe the present condition of oils. Its constitute one of the essential components of balanced diet as good source of energy. The study indicated that Peanut oil, may have a higher shelf life, nutritional value and industrial applications. Vegetable oil had made an important contribution to the diet in many countries [**11**].

Aim of this study is to investigate and evaluate physical composition and chemical composition of Groundnut seed varieties of Rajasthan Nagori RD 1:10(RRD1:10), G10 Gujarat(G10G), Shivpuri (Sv), Rajasthan Gugeri(Rg) and Tag(Tg) which are having different geographical places. In this study the groundnut seeds of different places were assessed and analyzed for yield of extracted oil. The extracted oils were analyzed for physical and chemical parameters, such as refractive index, specific gravity, viscosity, iodine value, acid value, saponification value and unsaponifiable matter etc.

2. Material and methods

2.1 **Procurement of Materials**

The physical and chemical analysis of seeds and extracted oil were based on five peanut varieties namely Rajasthan Nagori RD 1:10 (RRD1:10), G10 Gujarat (G10G), Shivpuri(Sv), Rajasthan Gugeri (Rg), and Tag (Tg) have been used for cultivation in arid zone as well as irrigated regions of Rajasthan, Madhya Pradesh and Gujarat then used for extraction of oil which was provided by oil mills association, Jalgaon (Maharashtra). The seeds and pod shells were separated manually. For analysis, mature and healthy seeds were stored in grinded form in glass containers. The chemical reagents and glassware used in this research work are analytical grade.

2.2 Methods

2.3 Extraction of oil of collected seeds

The groundnut oil seed were purchased from local market. The groundnut seeds were separated from shaft by hand picking method .The seeds were freed of the dirt were collected into a separate pre cleaned beaker .from each sample 500 g were crushed and weighed using commercial grinder and fed to a soxhlet extractor and hexane was used as the extraction solvent, equipped with thimble and fitted with a 2 L round bottomed flask .The extraction was carried out for a period of 8 hours. At the end of the extraction period, the solvent was recovered by using a rotary evaporator and residual oil was dried at 75^0 C for one hour. The extract was transferred to desiccators and then stored in air tight container until needed for further analysis **[13].**

The amount of oil extracted was determined using the following equation

Oil content (%) = weight of oil extracted / weight of seed x100

2.4 Determination of physical and chemical properties of extracted oil

The extracted oil was immediately analyzed for chemical properties, such as iodine, acid and saponofication value, ester value and unsaponifiable matter while specific gravity, viscosity, refractive index, impurities and colour were examined for physical properties. The refractive indices of the oil at room temperature were determined with Abbe/ Butyro Refractometer and the specific gravity measurement (also carried out at room temperature), using specific gravity bottle.The state and colour of the oil were noted, using Lovibond tintometer at room temperature. Viscosity measurement with Hakke viscometer (rheoVT550) at room temperature and yield were determined, using the method described by the association of official chemists (**AOAC)** . Results are expressed as the means of three separate determinations.

2.4.1 Determination of Physical Properties of extracted oil

Results of the physical properties of the selected oils examined are shown in **Table 1.**

2.4.2 Determination of colour

The method determines the colour of oils by comparison with Lovibond glasses of known colour characteristics. The colour is expressed as the sum of the yellow and red slides used to match the colour of the oil in a cell of the specified size in the Lovibond Tintometer. Clean the glass cell of desired size with carbon tetrachloride and allow it to dry. Fill it with oil and place the cell in position in the tintometer. Match the colour with sliding red, yellow and blue colours. Reports the colour of the oil in terms Lovibond units as follows **[9]**.

$$\textbf{Colour reading} = (a\,Y + 5\,b\,R) \quad \text{---------- (ii)}$$

Where, a= sum total of the various yellow slides (Y) used, b = sum total of the various red (R) slides used

2.4.3 Determination of the Refractive index at 40 ^{0}C

Measurement of the refractive index of the sample is done by means of a suitable Butyro refractomater at 40^0C, a refractometer was used to measure the refractive index of extracted oils. Distilled water which has refractive index 1.3330 at 20^OC and 1.3306 at 40^OC, the usual temperature of taking readings Make sure sample is completely dry, circulate stream of water through the instrument. Adjust the temperature of the refractomater to the desired temperature. Ensure that the prisms are clean and dry. Place a few drops of the sample on the prism. Close the prisms and allow standing for 1-2 min. Adjust the instrument and lighting to obtain the most distinct reading possible and determining the refractive index or butyro-refractometer number. **[9]**.

2.4.4 Determination of Specific gravity

The specific gravity of extracted oil was recorded as a general measure of oil density compared to the density of water**.** This is useful for physically comparing and identifying oils. The specific gravity was determined using the specific gravity bottle method. The following formula was used to calculate the specific gravity of extracted oils **DGHS,(2012)** [**18]**.

Specific gravity = (weight of bottle + oil) - (weight of bottle) /(weight of water)----(iii)

2.4.5 Impurities

Two grams (2 g) of oil was weighed into a 500 ml flask and mixed with 20 ml of a 1:1 solvent (petroleum ether and diethyl ether). The contents were vigorously shaken, covered, and allowed to stand for 24 hours. The mixture was filtered through a weighed 11 cm qualitative filter paper. The paper was then washed with 10 ml of the 1:1 solvent and placed in an oven at 103 ºC for one hour. The dried paper was then weighed. The impurity (%) of oil was calculated with the following formula [**9**].

$$\textbf{Impurities (\%)} = (w_2 - w_1)/w_3 \quad \text{---------- (iv)}$$

w_2 = Weight of paper before filtering, w_1 = Weight of paper after filtering, w_3 = Weight of initial sample.

2.4.6 Determination of Viscosity

The viscosity of extracted oil was measured as an additional proxy for fat unsaturation, as prior studies have described an inverse relationship between viscosity and fatty acid unsaturation in oils **Abramovic et al (2012)** [1]. Viscosity was determined at room temperature25^{0}C, using a Hakke viscometer (rheo VT550).

2.5 Determination of Chemical Properties of extracted oil

Results of the chemical properties of the selected oils examined are shown in **Table 2.**

2.5.1 Determination of Acid value

The acid value, an indirect measurement of free fatty acid levels, was recorded to test the oils' freshness and likeliness to develop taste and odor defects [**3**]**.** The acid value is determined by directly the oil in an alcoholic medium against standard potassium hydroxide/sodium hydroxide solution. Mix the oil or melted fat thoroughly before weighing. Weigh accurately about 5to 10gof cooled oil sample in a 250 ml conical flask and 50 ml to 100 ml of freshly neutralised hot ethyl alcohol and about one ml of phenolphthalein indicator solution. Boil the mixture for about five minutes and titrate while hot against standard alkali solution shaking vigorously during the titration [**9]**.

$$\text{Acid value} = (56.1)\,(V)\,(N) / W \quad \text{---------- (v)}$$

Where V = Volume in ml of standard sodium hydroxide solution used, N = Normality of the standard sodium hydroxide solution, and W = Weight in g of the sample.

2.5.2 Determination of Iodine value (Wij's method)

The iodine value of an oil / Fat is the number of grams of iodine absorbed by 100 g of the oil /fat, when determined by using Wijs solution. The oil / fat sample taken in carbon tetrachloride is treated with a known excess of iodine monochloride is treated with glacial acetic acid Wijs solution) The excess of iodine monochloride is treated with potassium iodide and the liberated iodine estimated by titration with sodium thiosulphate solution .The iodine value is a measure of the amount of unsaturation (number of double bonds) in a fat **[9]**.

$$\text{Iodine value} = 12.69\,(B- S)\,N / W \quad \text{---------- (vi)}$$

Where, B = volume in ml of standard sodium thiosulphate solution required for the blank, S = volume in ml of standard sodium thiosulphate solution required for the sample, N = normality of standard sodium thiosulphate solution, W = weight in g of the sample.

2.5.3 Determination of Saponofication value

Two grams (2 g) of oil was dissolved in 25 ml of alcoholic potassium hydroxide. The mixture was refluxed for 45 minutes and then cooled. 1 ml of phenolphthalein indicator was added. The solution was titrated using 0.5 M HCL. A blank determination was conducted. The oil sample is saponified by refluxing with a known excess of alcoholic potassium hydroxide solution. The alkali required for saponofication is determined by titration of the excess potassium hydroxide with standard hydrochloric acid [**9]**.

$$\text{Saponification value} = 56.1\,(B- S)\,N / W \quad \text{---------- (vii)}$$

Where, B= Volume in ml of standard hydrochloric acid required for the blank, S = Volume in ml of standard hydrochloric acid required for the sample, N = Normality of the standard hydrochloric acid, W = Weight in gm of the oil .fat taken for the test.

2.5.4 Determination of ester value

The ester value is the 'mg' of KOH required to react with glycerol/ glycerin after saponify 1 g of oil sample. Ester value is calculated by the following relation

$$\text{Ester Value} = \text{Saponification Value} - \text{Acid Value}$$

2.5.5 Determination of Unsaponifable matter

The Unsaponifable matter was determined using the neutralized liquid after titration for the determination of saponification value. The neutralized liquid was transferred quantitatively into a separating funnel using 50ml of water for washing the flask. Add to the flask 50ml of

petroleum ether, shake vigorously, and allow the layers to separate. Transfer the lower soap layer into another separating funnel and repeat the ether extraction for another 3 times using 50 ml portions of petroleum ether. Wash the combined ether extract three times with 25 ml portions of aqueous alcohol followed by washing with 25 ml portions of distilled water to ensure ether extract is free of alkali (washing are no longer alkaline to phenolphthalein) Transfer ether solution to 250 ml beaker, rinse separator with ether ,add rinsing to main solution. Evaporate to about 5 ml and transfer quantitatively using several portions of ether to Erlenmeyer flask previously dried and weighed. Evaporate ether .When all ether has been removed add 2-3 ml acetone and while heating on steam or water bath completely remove solvent under a gentle air. To remove last traces of ether, dry at 100 0C for 30 minutes till constant weight is obtained dissolve residue in 50 ml of warm ethanol which has been neutralised to a phenolphthalein end point. Titrate with 0.02 N NaOH [**9**].

Weight in g of the free fatty acids in the extract as oleic acid = (0.282) (V) (N)
Where, V = Volume in ml of standard sodium hydroxide solution, N = Normality of standard sodium hydroxide solution

Unsaponifable matter = 100 (A- B) / W ---------- (viii)

Where, A = Weight in g of the residue, B = Weight in g of the free fatty acids in the extract
W = Weight in g of the sample.

3.0 Statistical Analysis

Accuracy of Different parameters for different varieties of Groundnut seeds have been analysed by calculating standard deviation and coefficient of variance and standard error mean of all the above parameters (Table 3).

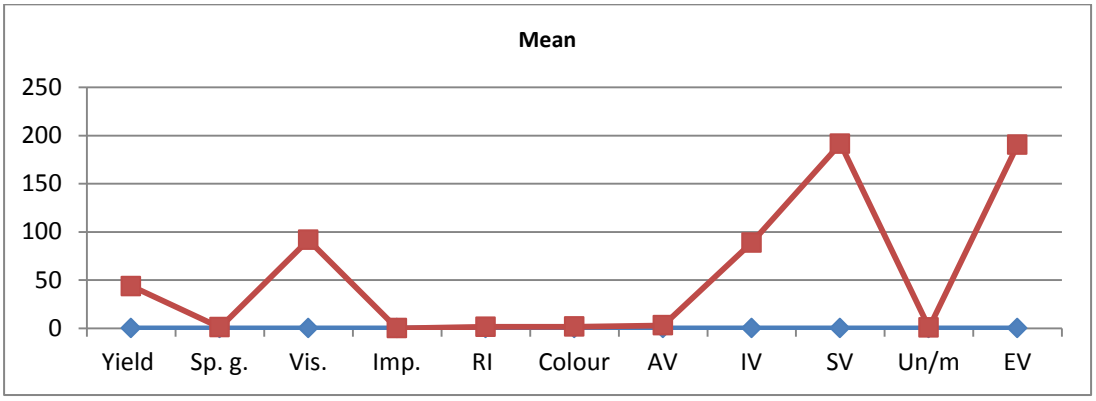

Fig.1.Descriptive statistics of different groundnut varieties

4. Results and discussion

Results of the physical characteristics of the different varieties of groundnut seed extracted oil were investigated (table 1**)**, the colour in yellow units ranges from 1.22 to 2.10 on Lovibond tintometer. Specific gravity ranges from 0.9148 to 0.9160 for all the varieties of groundnut. The value of the viscosity of the various oils extracted fell outside the recommended standard range of 91.56 to 91.76. The refractive index analysis shows the values between 1.4625 and 1.4634. The presence of some impurities and other components of the crude oil mixture ranges from 0.03-0.06%.

Result of the chemical characteristics of the different varieties of groundnut seed extracted oil were investigated (table 2**).** Results obtained from this work indicate that the acid value of the oils as determined range from 1.22-2.10 mg KOH/g oil. The saponification values of the various oils were found to be in ranges from 188.88 to 193.23. The iodine values show increase in the

average degree of un-saturation of the oil, as /such, the amount of iodine which can be absorbed by unsaturated acids would be higher and ranges from 85.75 to 91.84. Unsaponifiable matter in the range from 0.50.68, ester value ranges from 186.91-192.1, As a result of their agreement with standard, all the oils could be classified as non-drying oils; since their iodine values are lower than 100 (gI_2/100 g sample) . Certainly, those oils whose values are less than 100 (g I_2/100 g sample) could be used extensively as lubricants and hydraulic brake fluids.

5. Conclusion

The physicochemical properties of different varieties of groundnut seed oils have been analyzed and compared. The results of this study have shown that the oils, on average have high shelf lives and can be stored for long time. As the high SV and low IV in the nuts shows that the oils are of good nutritional value and are good quality and could be recommended as suitable for cooking and industrial application. It can therefore, be suggested that the groundnut oils pose no significant health risks to the consumers in India. From the physicochemical characterization, all the oils have very low degree of unsaturation and could be classified as non-drying oils. The percentage oil content of most of the seeds selected from different varieties of groundnut, show them as high oil.

Table1: Physical properties of different groundnut extracted seed oils.

Sr. No	Oils / Name of varieties	Yield (%)	Specific gravity	Viscosity at 25^0C/CP	Impurities (%)	RI at 40^0C	Colour (Yellow unit)
1	**RRD1:10**	44.29 ± 0.249	0.9155 ± 0.00	91.76 ±0.048	0.03 ±0.0073	1.4628 ±0.0001	1.22 ±0.176
2	**G10G**	44.95 ± 0.519	0.9156 ±0.00	91.68 ±0.058	0.05 ±0.0008	1.4634 ±0.0001	1.58 ±0.029
3	**Sv**	40.81 ± 1.173	0.9148 ±0.000	91.57 ±0.027	0.05 ±0.0008	1.4625 ±0.0002	1.48 ±0.070
4	**Rg**	43.85 ± 0.0694	0.9152 ±0.00	91.56 ±0.035	0.06 ±0.0048	1.4630 ±0.00	2.10 ±0.183
5	Tg	44.49 ± 0.331	0.9160 ±0.0002	91.62 ±0.026	0.05 ±0.0008	1.4632 ±0.0001	1.88 ±0.0931

*** Each value is an average of three determinations, Values are mean ± SEM (standard mean error),**
RI-Refractive index

Table 2: Chemical Properties of different groundnut extracted seed oils.

Sr. No	Oils /Name of varieties	AV* (mg KOH/g)	IV* (Wijs)	SV* (mg KOH/g)	Unsaponifiable matter* (g/kg)	EV*
1	**RRD1:10**	3.48 ±0.2124	85.75 ±1.2547	191.68 ±0.05313	0.68 ±0.0408	192.1 ±0.6989
2	**G10G**	4.28 ±0.5394	91.8 ± 1.2179	191.28 ±0.1103	0.54 ±0.0163	188.8 ±0.6498
3	**Sv**	1.18 ±0.7275	87.96 ±0.3515	188.88 ±1.0912	0.50 ±0.0326	186.91 ±1.4223
4	**Rg**	3.28 ±0.1307	91.84 ±1.2343	193.23 ±0.6866	0.62 ±0.01634	192.08 ±0.6907
5	Tg	2.58 ±0.1553	86.75 ±0.8460	192.68 ± 0.4618	0.58 ±0.000	192.1 ±0.6989

AV-Acid value, IV-Iodine value, SV-Saponification value, EV-Ester value, * Each value is an average of three determinations, values are mean ± SEM (standard mean error)

Table3. Accuracy of different parameters for different varieties of groundnut

Sr. No	Name of parameter	RRD1:10		G10 G		Sv		Rg		Tg	
		SD	CV	SD	CV	SD	CV	SD	CV	SD	CV
1	% oil content	0.4313	0.9874	0.898	2.0559	2.0293	4.6460	0.1202	0.2751	0.5727	1.3111
2	Colour	0.3054	18.49	0.0509	3.081	0.1216	7.362	0.3167	19.175	0.1612	9.759
3	Sp. Gravity	$0.7*10^{-4}$	0.07	$0.1*10^{-3}$	0.015	$0.1*10^{-3}$	0.015	$0.1*10^{-3}$	0.015	$0.4*10^{-3}$	0.046
4	Viscosity	0.084	0.091	0.093	0.101	0.044	0.048	0.056	0.061	0.014	0.015
5	Impurities	0.0127	26.458	0.0014	2.946	0.0014	2.946	0.0084	17.67	0.0014	2.946
6	RI at40^{0}C	0.0001	0.0096	0.0003	0.0193	0.0004	0.0241	0.0000	0.0000	0.0001	0.0096
7	AV	0.3676	12.422	0.9333	31.533	1.2586	42.5219	0.2262	7.6443	0.2687	9.0777
8	IV	2.1708	2.4440	2.1071	2.3724	0.6081	0.6846	2.1354	2.4042	1.4637	1.6479
9	SV	0.09192	0.0479	0.1909	0.02076	1.8879	0.9856	1.1879	0.9856	0.7990	0.4171
10	Unsap. Matter	0.0707	12.1914	0.0282	4.8765	0.05656	9.7531	0.02828	4.8765	0.00	0.00
11	EV	1.2091	0.6350	1.1242	0.5905	2.4607	1.2924	1.1950	0.6276	1.2091	0.6350

SD-Standard deviation, CV-Coefficient of variance

6. ACKNOWLEDGEMENTS

I would like to thanks to Jalgaon oil mills association for providing different groundnut varieties for this research study.

7. References.

1. **Abramovic et al (2012),** Abramovic H, Klofutar C., The Temperature Dependence of Dynamic Viscosity for Some Vegetable Oils. Acta Chimica Slovenica, **45(1): 69**-77.
2. **Adeyeye et al (1992).,**Adeyeye A. and Ajewole K.. Chemical Composition and Fatty acid profiles of cereals in Nigeria. Food Chem. **44: 41-44.**
3. **Akinyeye et al (2011).,** Akinyeye RO, Adeyeye EI, Fasakin O, Adedunke AA., Physicochemical Properties and Anti-nutritional Factors of Palm Fruit Products (Elaeis guineensis jacq.) from Ekiti State, Nigeria. Electronic Journal of Environmental, Agricultural, and Food Chemistry, **10(5): 2190-2198.**
4. **Ahmed et al,(1982)**,Ahmed, E.H. and C.T. Young, Composition, nutrition and flavour of peanuts. In: Peanut Science and Technology, (Ed.): H.E. Pattee and C.T. Young. American Peanut Research and Education Society, (pp. 655-658). Inc., Yoakum, Texas, USA.
5. **Barku et al (2012).**, Barku V. Y., Nyarko, H. D., and Dordunu, P., Studies on the Physicochemical Characteristics, Microbial Load and Storage Stability of Oil from Indian Almond Nut (Terminalia Catappal.), Food Science and Quality Management, **8. 9-17.**
6. **Brown et al,(1975)**,Brown, D.F., C.M. Cater, K.F. Mattil and J.G. Darroch, Effect of variety, growing location and their interaction on the fatty acid composition of peanuts. Journal of Food Science, 40: 1055-1060.
7. **Campos et al (2009).,** Campos - Mondragon MG, Calderon AM, Dela Barca A, Duran-Prado,Campos-Reyes LC, Oliart-Ros RM, Ortega-Garcia J, Medina-Juarez LA, Angulo O ., Nutritional composition of new peanut (Arachis hypogaea L.) cultivars, Grasos Y. Aceites, **60: 161-167.**
8. **CMIE** (**2000),** India's agricultural sector: A Compendium of statistics, Bombay, India: Center for Monitoring Indian Economy Pvt. Ltd.
9. **DGHS,(2012**)., Directorate General of Health Services, Manual of Methods of Analysis of Foods Oils and Fats),FSSAI, Ministry of Health and Family Welfare, Government of India, New Delhi62,67,70,72,75,78,90.

10. **FAO (2009)**. Food and Agriculture Organization. FAOStat. Food and Agriculture Organisation of the United Nations, Rome, Italy. Available at: http://faostat.fao.org/default.aspx.
11. **Grosso et al (1997).,**Grosso, N. R., Lucini, E. I., López, A. G., and Guzmán, C. A., Chemical composition of aboriginal peanut (Arachis hypogaea L.) seeds from Uruguay.Grasas y aceites, **50(3), 203-207.**
12. **Miller et al,(1987)**,Miller, J.F., D.C. Zinnerman and B.A. Vick., Genetic control of high oleic acid content of sunflower oil. Crop Science, 27: 923-926.
13. **Pearson(1981)., Pearson D.**., The Chemical Analysis of Food. (8thedition). Longman Group Ltd: **535**.
14. **Savage et al (1994).,** Savage GP, Keenan JI., The composition and nutritive value of groundnut kernels. In: Smart J. (ed). The Groundnut Crop: Scientific basis for improvement, London: Chapman and Hall,**173-213**. Springer, Netherlands.