Journal of AgriSearch **4**(1):51-54
An Open Access International Peer Reviewed Quarterly

ISSN : 2348-8808 (Print), 2348-8867 (Online)
http://dx.doi.org/10.21921/jas.v4i1.7420

Chemical and Physical Properties of Sri Lankan Medium Seeded Groundnuts (*Arachis hypogaea* L) Genotypes

RAA RANATHUNGA*, YPJ AMARASINGHE AND GTN GUNASEKARA
Grain Legume and Oil Crops Research and Development Centre, Angunakolapalessa, Sri Lanka

ARTICLE INFO

Received on	:	27.12.2016
Accepted on	:	31.02.2017
Published online	:	01.03.2017

ABSTRACT

Physical properties of commonly grown Sri Lanka groundnuts cultivars and promising accession varied considerably and numbers of kernels, pod beak, reticulation, testa colour, and shell out percentage have differences among groundnuts. However, they showed more similarities for most of the characters. Moisture (5.4-8.4%), crude protein (18.7-28.5%), lipid (43.4-53.0%), ash (4.4-5.8%), carbohydrates (9.3-18.2%) and energy level (565.7-618.2kcal) contents varied considerably. Quality and flavor of edible groundnuts and its products are affected by fatty acid composition of oil. Lipids were mainly composed of mono and polyunsaturated fatty acids (>78% of the total lipids). Fatty acid composition analysis indicated that oleic acid (C18:1) was the main constituent of monounsaturated lipids in all seed samples. With the exception of ANKG1, linoleic acid (C18:2) was the major polyunsaturated fatty acid. The saturated fatty acids (Palmatic, Stearic acid and behenic acid) in different cultivars ranged between 10.2 to 15.6%, 2.5 to 6.3% and 1.1 to 5.3%, respectively. Differences among cultivars for oleic acid exhibited significance which ranged between 38.2 to 47.4%. Similarly, cultivars differed statistically for linoleic acid which showed a range of 23.1 to 38.7%. Oleic to linoleic acid ratio was differed and all the released varieties were below the minimum standard level of 1.6, whereas ICGV 86590 and ICGV 00073 showed higher O/L ratio of 1.94 and 1.75 respectively.

Keywords: Arachis hypogaea, Physical, Chemical, Fatty acid profile

INTRODUCTION

Groundnuts are cultivated in variety of growing condition and climates as major oil crop, and are valued for their sensory, nutritional and health attributes (Singh *et al*., 2015). Groundnuts are universally popular and used as a snack food or as an ingredient in the manufacture of a variety of food products such as peanut butter and peanut brittle (Venkatachalam and Sathe, 2006). This annual plant is generally distributed in the tropical, sub-tropical and warm temperate areas and represents the second most important legume in the world based on total production after soybean (Pattee, 1982). Botanically, groundnut is a legume, although it is widely identified as a nut and has similar nutrient profile with tree nuts (Ros, 2010). In 2012, groundnut cultivated extend of Sri Lanka was 11,609 and production was 21,953t with average yield of 1.89t/ha (Department of Agriculture, 2013). The groundnut seed is rich in oil (48-49%) and protein (about 26%) (Adeyeye, 2012). The content of oil has been stated to depend on the richness of the soil and the conditions of the cultivation rather than on the variety grown, the percentage being greater in nuts grown in warm than in temperate climates (Adeyeye, 2012). It is a rich source of minerals (phosphorus, calcium, magnesium, and potassium) and vitamins (E, K, and B group) (Savage and Keenan, 1994).
The nutritional and storage qualities of groundnuts depend on the relative proportion of saturated and unsaturated fatty acids in the oil (Savage and Keenan, 1994). Fatty acid profiles of oil crops are important for the value addition, oil extraction and shelf life of the edible oils. Chemical composition analysis of edible nuts are revealed that lipids mainly composed of mono and poly unsaturated fatty acids (75% of the total lipids) and oleic acid (C18:1) was the main constituent of mono unsaturated fatty acid in all seed samples, with the exception of macadamia, linoleic acid (C20:2) was the major unsaturated fatty acid (Venkatachalam and Sathe, 2006). There is a strong negative correlation between oleic and linoleic acids have been reported in groundnuts (Dwivedi, 1993) and other oil seed crops like brassica (Hassan, 2007) and sunflower (Hassan, 2011). The information related to physical properties, chemical composition and fatty acids profile of medium size groundnut grown in the country are scarce, The present study was planned with the objective of determining the physical properties, proximate composition and fatty acid profile of released varieties and promising lines of groundnuts, which are important for breeding, processing and keeping quality of value added products.

MATERIALS AND METHODS

Four released medium size groundnuts varieties and three ICGV promising groundnut lines were planted in a field according to randomized complete block design (RCBD) with two replicates. After harvesting, dry pods were collected from oil crops division of Grain Legume and Oil Crops Research and Development Centre (GLORDC), Angunakolapelassa, Sri Lanka. Seeds samples were kept in a refrigerator until laboratory analysis. Unless otherwise specified, all analysis was done at room temperature (RT, 25°C). When needed, samples were powdered using grinder (Bajaj Model) and

*Corresponding Author Email : priyajayantha@gmail.com

were stored in airtight polyethylene pack at freezer, until further analysis.

Evaluation of physical properties of pods and kernels

As physical properties, pod characters, seed size, weight of 100 pods and kernels, shelling our percentage and colour of testa were collected. Experiment was designed as completely randomized design (CRD) with three replicate.

Proximate and fatty acid profile analysis

The standard methods of the Association of Official Analytical Chemists (AOAC, 1990) were used to determine moisture, ash, crude fat and crude protein content. Moisture content was obtained by heating three 3.0 g portions of the groundnut samples in an oven (Memmert, England) at 105°C until a constant weight was obtained. Ash determination was obtained by the incineration of three 2.0-3.0 g samples in a muffle furnace at 550°C when a light-grey ash was produced. Crude protein was obtained using three 2.0 g portions of the samples. The crude protein was calculated by a multiplying factor (%N × 6.25).

The crude fat was determined by extraction procedure using three 1.0-2.0 g samples in a Soxhtherm apparatus using petroleum spirit (40 - 60°C) as the solvent. The extracted oil was stored at -20 °C under nitrogen until further analysis.

Lipids were analyzed for total, saturated, and unsaturated fatty acids. Lipids were acid hydrolyzed and subjected to direct methylation prior to gas chromatographic (GCMS) analysis. The GCMS methodology details were as follows (Table 1)

Table 1: Condition of GCMS used to analyze fatty acid profile

GC	Shimatzu 2010 plus
Column	Rtx-1(Restek)
Carrier gas	He
Injector mode	Split
Column flow	1ml/min
Inlet temperature	240°C
Column oven temperature	100°C
Oven temperature	Initial:100°C(Hold 1 min) 100°C to 250°C (10°C/min)
Total run time	26.00 min
MS	Shimatzu 2010 ultra
Ion source temperature	150°C
Interface temperature	200°C
Acquisition mood	Scan

All data were corrected for recoveries and expressed as grams per 100 g of lipid.

RESULTS AND DISCUSSION

Physical properties of pods and kernels

Pod characteristics were highly varied according to the varieties and lines. In general, number of kernels per pod was ranged from 1 to 2, except "ICGV 86590" which had 3 kernels pod as well (Table 2 and Table 3). Pod beak was prominent in "ICGV 00073" and absent in variety "Tissa" and "ANKG1". Pod reticulation was prominent in "ICGV 86590" and all other types varied from slight to moderate. Pod constriction was varied in the groundnut and deep constriction can be seen in variety "Indi". Pod shape was mainly two types and most of them were vulgaris.

Table 2: Morphological characteristics of medium size groundnuts pods

Varieties /lines	No of Kernels / Pod	Pod beak	Pod Reticulation	Pod Constriction	Pod shape
Tissa	1 to 2	Absent	Sight to moderate	Non	Vulgaris
ANK G1	1 to 2	Absent	Smooth	Slight	Vulgaris
Tikiri	2	Slight	Smooth	Slight	Hypogaea
Indi	1 to 2	Slight	Smooth	Deep	Vulgaris
ICGV01276	1 to 2	Slight	Moderate	Slight	Vulgaris
ICGV 00073	1 to 2	Prominent	Smooth	Slight	Hypogaea
ICGV 86590	1, 2 and 3	Slight	Prominent	Moderate	Fastigiata

Table 3: Physical properties of medium size groundnut kernels

Variety/Line	weight of 100 pods	Weight of kernels of 100 pods	Shell out %	Weight of 100 kernels	Testa colour
Tissa	80.9d	60.2de	74.5a	37.6	Light pink
ANKG 1	83.5d	58.1ef	69.5cd	36.4	Red
Tikiri	95.3c	69.2b	72.6ab	38.5	Light pink
Indi	83.5d	59.6de	71.3bc	41.7	light pink
ICGV 01276	97.5bc	64.0cd	65.5e	54.3	light pink
ICGV 00073	101.9b	65.8bc	64.5e	41.1	Dark red
ICGV 86590	123.3a	82.4a	68.8d	41.7	light pink

Note: Within the column, the means followed by the same letter are not significantly different at p=0.05.

Proximate composition

The moisture content of medium size groundnuts were significantly ($p<0.05$) different and ranged in between 5-9%. Variety "Tikiri" had 8.4% moisture level and higher the percentage over others (Table 4). However, low moisture content important for increasing quality parameters and shelf life of the seeds. Low moisture content was enhanced in reducing microbial contamination and many undesirable biochemical changes. The recorded data was agreed with the finding of Musa et al., 2010. Ash content was significantly ($p<0.05$) different and ranged between 4 to 6%. The crude fat content was significantly ($p<0.05$) different among the samples and ranged 43 to 53% (Hassan and Ahmed, 2012). Crude protein content was significantly ($p<0.05$) different and accession "ICGV 00073" had higher value than other groundnuts whereas lowest crude fat level with 28.5% and 43.4% respectively. Carbohydrates content was also significantly ($p<0.05$) different among the groundnuts and accession "ICGV 01276" had lowest value. Energy content per 100g was significantly ($p<0.05$) different among the groundnut and ranged between 565 to 618kcal. Lowest energy was reported by accession "ICGV 00073".

Table 4: Proximate composition and enegy level of medium size kernels of groundnut

Varieties/lines	Moisture %	Ash %	Crude fat%	Crude protein %	Carbohydrate %	Energy
Tissa	5.4c	4.4b	47.0b	25.0b	18.2a	595.6c
ANKG1	6.2c	5.4a	53.0a	20.2ef	15.2ab	618.2a
Tikiri	8.4a	4.8b	50.7a	21.4de	14.7ab	601.0bc
Indi	6.5bc	4.8b	51.8a	18.7f	18.1a	614.1ab
ICGV01276	8.1ab	5.4a	52.7a	24.5bc	9.3c	609.7abc
ICGV00073	7.1abc	5.8a	43.4c	28.5a	15.2ab	565.7d
ICGV86590	6.7abc	5.6a	51.4a	22.5cd	13.8b	608.2abc

Note: Within the column, the means followed by the same letter are not significantly different at p=0.05.

Fatty acid composition of medium size ground nuts

Fatty acid composition of medium size groundnut kernels is consistent with the corresponding data in the Chowdhury *et al.*, 2015. Table 5 shown that all seeds contained predominantly unsaturated fatty acids (UFAs) ranging from 72.6% to 78.0% over saturated fatty acid (SFAs) ranging from 17.7% to 22.9%. There were significantly ($p<0.05$) differences for the saturated fatty acids (Fig. 1) and palmatic acid was the predominant, which was ranged from10.2% in ICGV 86590 and 15.6% in ANKG1 respectively with highest value, however a range of 12.2%-13.3% of palmatic acid reported in Malaysian cultivars by Berry (1982), and 9.9% to 10.7% reported by Hassan and Ahmed (2012). Thus, our results were consistent with berry findings than the Hassan and Ahmed. Stearic fatty acid was shown the significant ($p<0.05$) difference and ICGV 01276, ICGV 00073 and ICGV 86590 had higher amount. It was varied from 2.4% in Indi and 6.4% in ICGV 86590. This results were agreed with Ozcan and Sevens (2003) findings of 3.7% to 4.5%. In addition, behenic acid content was significantly ($p<0.05$) higher in accession ICGV 86590 than other tested groundnuts. It was amounted at 1.1% in Tikiri and 5.3% in ICGV 86590. This results were consistence with Ozcan and Sevens (2003) finding of 2.4% to 3.1%.

Table 5: Fatty acid profile of medium size groundnut kernels

Variety/Line	Tissa	ANKG1	Tikiri	Indi	ICGV 01276	ICGV00073	ICGV 86590	CV%
Total fat	46.9b	52.9a	50.7a	51.8a	52.7a	43.4c	51.4a	2.83
Saturated fat	19.0b	21.6a	17.7b	17.8b	22.6a	22.9a	22.6a	5.31
Unsaturated fat	74.2bc	76.6ab	78.0a	77.8a	72.8c	72.6c	72.9c	1.76

Note: Within the column, the means followed by the same letter are not significantly different at p=0.05.

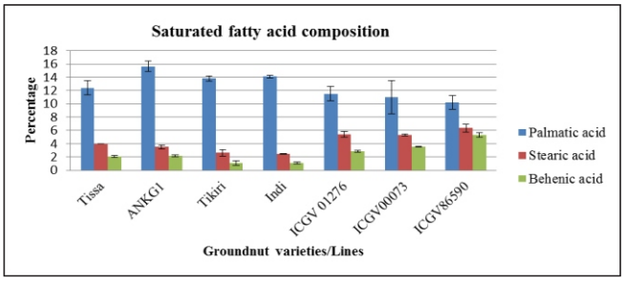

Fig.1: Major saturated fatty acid composition of medium size groundnut varieties and accessions (lines)

Mainly unsaturated fatty acids profiles were comprised of monounsaturated (oleic acid) and polyunsaturated (linoleic acid) fatty acids, while monounsaturated fatty acid was higher in most of the groundnut except ANKG1 (Fig. 2). The oleic acid content was significantly ($p<0.05$) different. The highest amounts was recorded in variety Tissa, Tikiri and accession ICGV 01276, around which was ranged from 38.2% in ANKG1 and 47.4% in Tissa. Ozcan and Sevens (2003) have reported similar oleic acid content for groundnuts, amounted of 43.1% to 55.1%. Hassan and Ahmed (2012) reported similar value of 49.3% to 54.8%. Next predominant unsaturated fatty acid was linoleic acid, which was significantly ($p<0.05$) different among the tested samples. Linoleic content was significantly ($p<0.05$) higher in ANKG1and amounted 38.7%, in contrast accession ICGV 86590 had least amount of 23.1%. Hassan and Ahmed (2012) reported 28.9% to 34.2%, while Ozcan and Sevens (2003) reported 25.1% to 35.2%. Those findings were agreed with our results.

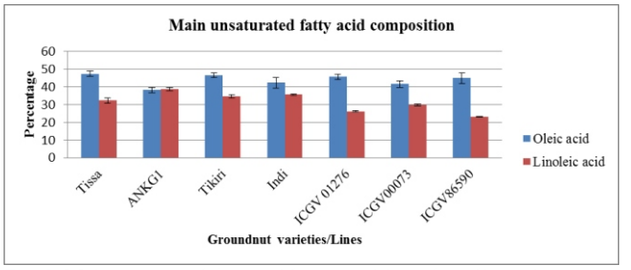

Fig. 2: Major saturated fatty acid composition of medium size groundnut varieties and accessions (lines).

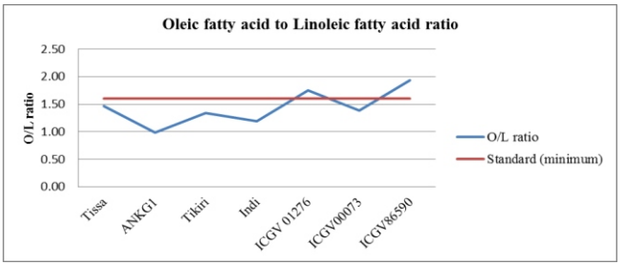

Fig. 3: Oleic acid to linoleic acid ratio of medium size groundnut varieties and accessions (lines)

The oleic acid to linoleic acid ratio is important for the shelf life of the groundnut oil (Fig. 3). The stability of oil mainly determine by the fatty acid composition, and especially the proportion of unsaturated to saturated fatty acid (ICRISAT, 1989). The fatty acid composition of released varieties and accessions showed that the oleic acid (O) to linoleic acid (L) ratio varied between 0.99 and 1.94, and the highest ratio was found in ICGV 86590 followed by ICGV 01276, which amounted at 1.94 and 1.75 respectively. O/L ratio more than 1.6 was showed desirable long shelf life and industries preferred in such ratio at least 1.6 in UK (ICRISAT, 1989). However, all the released groundnut varieties were far behind the minimum level of O/L ratio with world standard.

CONCLUSION

Physical properties analyses of groundnut indicated most of the medium size groundnuts are having 1 to 2 seeds in a pod except rarely found three seeds in ICGV 86590. Pod characteristics more or less similar in tested groundnuts with prominent beak in ICGV 00073 and pod reticulation in ANKG1. Highest pod weight was reported ICGV 86590, however, shell out percentage significantly high in Tissa and Tikiri. Predominant deep red coloured testa can be seen in ANKG1 and ICGV 00073. Chemical composition analyses of groundnuts revealed the seeds to be typically low in moisture and high in proteins and lipids. Groundnuts provide considerable amount of energy for daily requirement. The seed lipids represent more than 70% of unsaturated fatty acid and are a significant source of monounsaturated fatty acid and polyunsaturated fatty acid. Tested groundnuts had more than 40% oleic acid except ANKG1. Oil stability mainly depends on the ratio of oleic acid to linoleic acid. O/L ratio of all the released varieties were below the standard minimum level, however, accession ICGV 86590 and ICGV 00073 had higher level than standard.

ACKNOWLEDGMENT

The authors are grateful to Mr. Anura Senarathna, General Manager, Research and development and Quality Assurance, Cylon biscuits limited for the giving big contribution to analyze fatty acid profile of groundnut samples, and to Mr. Karunathilaka, Additional Director of Grain Legume and Oil Crops research and development center, Angunakolapalessa, for assistance in providing necessary advices.

REFERENCES

Adeyeye EM. 2012. Effects of roasting and cooking on the lipid composition of raw groundnut seed: dietary implications. *Elixir Food Science* **42**: 6257-66.

AOAC. 1990. Association of Official Analytical Chemists. Official methods of analysis. 13th edn. (Ed. Horwitz W) Washington DC, p1141.

Berry SK. 1982. Fatty Acid Composition of 16 Groundnut (*Arachis hypogaea* L.) Cultivars grown under Malaysian Conditions. *Pertanika* **5**(1): 20-4.

Chowdhury FN, Hossain D, Hosen M, and Rahman S. 2015. Comparative Study on Chemical Composition of Five Varieties of Groundnut (*Arachis hypogaea*). *World Journal of Agricultural Sciences* **11** (5): 247-54.

Department of Agriculture. 2013. AgStat- socioeconomis and planning centre, p 21.

Dwivedi SS. 1993. Effect of genotypes and environments on oil content and oil quality parameters and their correlation in peanut (*Arachis hypogaea* L). *Peanut Science*. 20: 84-9.

Hassan FA. 2007. Effect of sulphur on seed yield, oil, protein and *glucosinolates* of canola cultivars. *Int J Agri Biol*. **9**:504-9.

Hassan FS. 2011. Oil and fatty acid distribution in different circles of sunflower head. *Food Chem.* **128**:590-5.

Hassan FU and Ahmed A. 2012. Oil and fatty acid composition of peanut cultivars grown in Pakistan. *Pak. J. Bot.* **44**(2):627-30.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) 1991. Uses of tropical grain legumes: proceedings of a Consultants Meeting, 27-30 Mar 1989, ICRISAT Center, India. Patancheru AP India.

Musa AK, Kalejaiya DM, Ismaila LE, and Oyerinde AA. 2010.Proximate composition of selected groundnut varieties and their susceptibility to *Trogoderma granarium* everts attack. *Journal of Stored Products and Postharvest Research* **1**(2): 13-7.

Ozcan M and Seven S. 2003. Physical and chemical analysis and fatty acid composition of peanut, peanut oil and peanut butter from çom and nc-7 cultivars. *Grasas y Aceites*. **54** (1): 12-8.

Pattee HC. 1982. Peanut science and technology. American peanut research and education society. Inc Taxas, USA.

Ros E.2010. Health benefits of nut consumption. *Nutrients* **2**:652-82.

Savage GP and Keenan JI. 1994. The composition and nutritive value of groundnut kernels. The groundnut crop: A scientific basis for improvemet Ed. Smartt J. Chapman and Hall. London. pp.173-213.

Singh AK, Prakash V and Verma N. 2015. Evaluation of potential runner type groundnut variety for its suitability during summer cultivation. *Journal of AgriSearch* **2** (2): 140-143.

Venkatachalam M and Sathe SK. 2006. Chemical composition of selected edible nut seeds. *Journal of Agricultural and Food Chemistry* **54:** 4705-14.

Citation:

Ranathunga RAA, Amarasinghe YPJ and Gunasekara GTN.2017. Chemical and physical properties of Sri Lankan medium seeded groundnuts *(Arachis hypogaea* L*) genotypes*. *Journal of AgriSearch* **4**(1): 51-54