

## Case Study.

# Effect of Processing Method on the Proximate, Mineral and Fungi Properties of Groundnut (*Arachis hypogea*) Seed

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Raw, boiled and roasted groundnut (*Arachis hypogea*) seeds were analysed for proximate, mineral and fungi properties. The results revealed that the raw, boiled and roasted seeds contained 3.76%, 5.70%, 2.90% moisture, 24.5%, 16.11%, 20.57% crude protein, 47.9%, 38.81%, 50.11% fat, 11.31%, 18.04%, 13.05% carbohydrate, 3.04%, 2.70%, 2.90% ash, 9.49%, 18.64%, 10.47% fibre and 574.3kcal/g, 493.61kcal/g, 585.19kcal/g of energy respectively. There was a significant difference ( $p < 0.05$ ) between the raw and heat processed samples. Boiling increased moisture, carbohydrate and fibre contents, while crude protein, fat and ash decreased with boiling when compared to the raw and roasted groundnut. Minerals increased with heat processing. Sodium, potassium and magnesium ranged from 0.9%- 2.10%, 0.18%- 0.23% and 0.21%- 0.45% respectively with the raw sample having the least value. Whereas calcium ranged from 1.24% - 1.48%, iron ranged from 0.30% -0.39% with the boiled sample having the highest value. The groundnut samples had a total of six fungi isolates with varying degree of severity, including *Geotrichum candidum*, *Sclerotium rolfsii*, *Botrytis cinerea*, *Aspergillus niger*, *Rhizopus stolonifer* and *Penicillium italicum*. Heat processing eliminated *Sclerotium rolfsii* and *Aspergillus niger*, leaving *Geotrichum candidum* 80% and *Botrytis cinerea* 20%, in the boiled seed while *Rhizopus stolonifer* 80% and *Penicillium italicum* 20% were predominant in the roasted seeds.

**Keywords:** Processing methods, Groundnut, Proximate, mineral, fungi flora.

## INTRODUCTION

Groundnut (*Arachis hypogea*) is a specie in the legume or bean family (Fabaceae) and the most important legume in Africa (Sellscope 1962). It is an important crop of Brazilian origin, though now cultivated in tropical and temperate climates.

Groundnut is a good protein source and has a high lysine content which makes it a good complement for cereal protein which is low in lysine (Okaka 2005). The problem of providing adequate protein for an expanding world population is second only to the overall food problem (Pomeranz and Meloan 1987).

Peanuts are generally rich in nutrients, providing over 30 essential nutrients and phytonutrients (Peanut:Wikipedia the free encyclopedia). A new study by a group of Huntsville researchers found out that boiled peanuts bring out up to four times more chemicals that help protect against disease than raw, dry or oil roasted nut. Recent research has also found antioxidants that protect cells against the risk of degenerative disease and other

chemicals that may provide health benefits (Peanut at the world's healthiest food 2007-<http://www.ask.com>).

Groundnut has being used in and around the food industry as food in soups, stew, sauces, puddings, bakery products and in various other ways (Onyenuga 1968) such as production of solvents and oils, make-up, medicines, textiles materials, peanut butter, mixed nuts (Peanut: Wikipedia the free encyclopedia).

In Nigeria, there are two major local forms in which groundnut seeds are consumed amongst others. It is either by roasting or boiling. Boiled and roasted groundnuts are common street side food in south-south Nigeria. Freshly boiled or roasted groundnut is a good traditional snacking item with its unique taste.

However, there is an increased preference for roasted seeds in comparison to boiled groundnut. The aim of the study therefore is to determine the effect of processing (cooking method) on the nutrient composition and fungi properties of groundnut seeds.

## MATERIAL AND METHODS

**Materials: 1500g of** Fresh groundnut seeds were procured from Mile I Market in Port Harcourt, Rivers State. Three sets of experiments were laid out. In the first set, 500g seeds were oven dried at 50°C for 48hours, milled and stored for analysis. The second set 500g seeds were roasted and the third set 500g seeds were boiled.

### Sample preparation:

#### Roasting of Groundnut:

20g Salt in 50ml of water was sprinkled on the groundnut seeds and sun dried for one hour and fried in an open pan using gari (gari was used to avoid sand) at the base until the seeds turned golden brown. Roasted groundnut seeds were cooled, dehulled, milled and stored in an airtight container for further analysis.

#### Boiling of Groundnut:

Unshelled groundnut seeds were thoroughly washed in cold water until water was clear. Nuts were soaked in clean water for about 30 mins before cooking. Cooking was done in a pot with 1.5liter of water. 20g of salt was added, cooked for about 30mins while stirred occasionally. Fully cooked groundnut seeds was soft and similar to that of a cooked dry pea or bean in texture. When cooking was terminated, the remaining water was drained to avoid further moisture uptake by the groundnut. Groundnuts were dehulled, dried, milled and stored for further analysis.

**Methods:** Proximate analysis of groundnut samples was determined by the AOAC (1990) method. In brief, moisture content was determined by using 5g sample in an air oven method at 105°C for 4 hours. 2g sample used for the determination of moisture was wrapped in a filter paper and clipped in the sohxlet extraction unit with 50ml petroleum spirit attached on the heating plate. The petroleum spirit was connected to a reflux for 3 hours and thereafter evaporated to dryness at 100°C for 5min. Ash was done using 3g sample each inside a muffle furnace at a temperature of 600°C for 8 hours while protein was determined using the micro-kjeldahl method with 1g sample each. Total available carbohydrate was done using 1g sample in a 100ml measuring cylinder with 10ml water added. 13ml of 52% perchloric acid was added and allowed for 20min to digest. Sample was filtered and 10ml

of extract diluted to 100ml. 1ml of diluents in 5ml of freshly prepared anthrone reagent was placed in a boiling water bath for 12min and absorbance read at 630nm while fibre was calculated by difference.

### Mineral evaluation of groundnut samples

The mineral elements in the groundnut samples (calcium, magnesium, potassium, phosphorus, iron and sodium) were determined by the method of Osborne and Voogt (1978).

### Mycological Studies:

1g groundnut seed of each sample was placed in Petri dishes containing potato Dextrose Agar (PDA) prepared using the standard method. Three replicate were made for each of the groundnut seed samples and incubated for seven days and monitored for mold growth. Pure cultures were made through series of isolation and inoculation onto sterile potato dextrose agar (PDA) in petri-dishes at room temperature. The fungi were identified at the end of the incubation period based on color, Spore morphology and the nature of the mycelia growth according to the method of Cheesebrough (1991) and Olds (1983).

### Statistical Analysis

Differences between means were assessed by analysis of variance (ANOVA) and means separated by Duncan Multiple range tests as reported by Steel and Torrie (1981).

## RESULTS AND DISCUSSION

### Chemical Composition of groundnut seeds samples.

Table 1 shows the chemical composition of raw, boiled and roasted groundnut seeds. The moisture content ranged from 2.90-5.70%, protein content 16.11-24.50%, fat 38.81-50.11%, carbohydrate 11.31-18.04%, ash 2.70-3.04% and fibre (by difference) 9.49-18.64% while energy (kcal) ranged from 493.61-585.19kcal/g.

The chemical composition of groundnuts may have been affected by heat processing. Crude protein, fat and ash decreased with boiling, while carbohydrate and fibre increased with boiling as shown in table 1. The moisture content of the boiled groundnut was higher than the raw and roasted groundnut. This was expected, due to the excess water in contact with the seeds during boiling, indicating that the cells of the nuts absorbed moisture. This is also responsible for the short storage time (shelf life). The moisture content falls within the range reported by Ayoola and Adeyeye (2010).

Table 1: Chemical composition of raw, boiled and roasted groundnuts seed (%) on dry weight basis.

Sample Code	MC	Protein	Fat	CHO	Ash	Fiber	Energy (kcal/g)
Raw	3.76 <sup>b</sup>	24.5 <sup>a</sup>	47.9 <sup>b</sup>	11.31 <sup>c</sup>	3.04 <sup>a</sup>	9.49 <sup>c</sup>	574.34 <sup>b</sup>
Boiled	5.70 <sup>a</sup>	16.11 <sup>c</sup>	38.81 <sup>c</sup>	18.04 <sup>a</sup>	2.70 <sup>a</sup>	18.64 <sup>a</sup>	493.61 <sup>c</sup>
Roasted	2.90 <sup>c</sup>	20.57 <sup>b</sup>	50.11 <sup>a</sup>	13.0 <sup>b</sup>	2.90 <sup>a</sup>	10.47 <sup>b</sup>	585.19 <sup>a</sup>

\*Means on the same column bearing the same superscript are not significantly different (P<0.05)

Keys

MC----Moisture content

CHO---Carbohydrate

Protein content of groundnut reduced with roasting and even further with boiling. Onyeike and Oguike (2003) reported that boiling brings about loss of structural integrity as well as a loss in protein, fat and ash and this also agrees with the findings of Ayoola and Adeyeye (2010). The lower crude protein of the boiled groundnut seed might also be as a result of leaching of soluble components of the protein into cooking water. This is in agreement with the findings of Jimoh *et al.*, (2011) in sesame seeds (*sesamum indicum*) and Adeparusi (2001) who also made similar observations when autoclaving lima beans, (*phaseolus lunatus* L). Crude protein content demonstrates that groundnut is a valuable source of protein in improving the nutrition status of humans. Fat content of both the raw and the roasted was higher than the boiled seeds. The reduction of fat as a result of boiling is in agreement with the work of Onyeike and Oguike (2003). Fat content of the various samples falls within the range reported by Asibuo *et al.*, (2008), and savage and Keenan (1994). Carbohydrate result of 11.31-18.04% falls within the range reported by Ayoola and Adeyeye (2010), Abdel Rahman (1982); Woodroof; (1983) and Onyeike and Oguike (2003). The loss in carbohydrate due to roasting may be attributed to the role of sugar as a precursor in the production of roasted groundnut flavour, where it provide a source of carbon for the production of flavour compounds (Koehler *et al.*, 1969). Ash content reduced with heat processing and was least in the boiled groundnut. This agrees with the findings of Atasi *et al.*, (2009). Energy value was highest in the roasted seeds and reduced with boiling. This reduction makes boiled groundnut suitable for people suffering from overweight and hyperlipidamia.

### Mineral composition of groundnut seeds

Table 2 shows the mineral content of raw, boiled and roasted groundnut seeds. Generally, processing increased the mineral content of the seeds. This is in agreement with the study of Ayoola and Adeyeye (2010) which stated that roasted groundnut was more advantageous in mineral content than the raw. Heating at higher temperature therefore released the minerals. Results of sodium, potassium, calcium and magnesium in the present study are higher than the values reported by Derise *et al.*, (1974), Ayoola and Adeyeye (2010). There was a significant difference (p>0.05) in all minerals (except iron (Fe<sup>+</sup>) between the raw, boiled and roasted groundnut samples. Sodium and calcium were found to have the highest minerals in the present study as shown in table 1 and these were made more available with heat processing. Calcium is vital for healthy teeth, bones, aids muscle growth and prevents muscle cramps. While potassium plays a large role in supporting the nervous system and natural heart rhythm. It also stabilizes blood pressure and helps in electrochemical transmission and that has been shown to prevent strokes and works with sodium to maintain a proper water balance in the body (Jannifer, 2009). Magnesium has also been reported to be involved in maintaining the electrical potential in nerves and activation of some enzyme system (Ferrao *et al.*, 1987). The high levels and availability of these minerals in groundnut is a good indication that groundnut consumption will aid in bone formation, blood clotting, muscle contraction and in certain enzymes in metabolic processes (Ayoola and Adeyeye (2010).

Table 2: Mineral content of Raw, Boiled and Roasted groundnut seeds (%) dry weight basis.

Sample code	Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>2+</sup>	mg <sup>2+</sup>	fe <sup>2+</sup>	p <sup>+</sup>
Raw	0.9 <sup>b</sup>	0.18 <sup>b</sup>	1.24 <sup>c</sup>	0.21 <sup>b</sup>	0.30 <sup>a</sup>	0.52 <sup>b</sup>
Boiled	1.8 <sup>c</sup>	0.22 <sup>a</sup>	1.48 <sup>a</sup>	0.42 <sup>a</sup>	0.39 <sup>a</sup>	0.56 <sup>a</sup>
Roasted	2.10 <sup>a</sup>	0.23 <sup>a</sup>	1.35 <sup>b</sup>	0.45 <sup>a</sup>	0.34 <sup>a</sup>	0.56 <sup>a</sup>

Means on the same column bearing the same superscript are not significantly different (p<0.05).

### Fungi isolate of groundnut seeds.

Table 3 shows the result of fungi isolates from the different groundnut seed samples. The raw groundnut seeds had a total of four fungi isolates with varying degree of severity which were *Geotrichum candidum* (40%) *Sclerotium rolfsii* (20%), *botrytis cinerea* (20%) and *Aspergillus niger* (5%). Boiled groundnut had two fungi isolates with the following severity, *Geotrichum candidum* (80%) and *Botrytis cinerea* (20%), while roasted groundnut also had two fungi isolate as follows, *Rhizopus stolonifer* (80%) and *penicillium italicum* (20%). The raw groundnut seed recorded the highest number of fungi, this is expected because no form of heat treatment was given and that gave room for more fungal growth. Boiled and roasted groundnut both had

two fungi isolates each with the same severity and yet different isolates. *Geotrichum candidum* which reoccurred in the boiled groundnut sample, is an indication that this isolate thrives best in samples with high moisture content as in the case of boiled groundnut seed. In agreement with this, Chuku *et al.*, (2009) reported that *Geotrichum candidum* caused soft rot of grains. The result has shown that heat treatment reduced the growth of more fungi and at the same time prevented the outright growth of *Botrytis cinerea*. Therefore it may be important to heat treat groundnut before consumptions because *Aspergillus* and *Penicillium* associated with nuts are know to have strains that produce toxic metabolites (Bamburg *et al.*, 1969, Cole and Cox 1981.)

Table 3: Fungal isolates of Raw, Boiled and Roasted Groundnut seeds and their Severity.

Samples	Fungal isolates	% severity
Raw	<i>Geotrichum candidum</i>	40
	<i>Sclerotium rolfsii</i>	20
	<i>Botrytis cinerea</i>	20
	<i>Aspergillus niger</i>	5
Boiled	<i>Geotrichum candidum</i>	80
	<i>Botrytis cinerea</i>	20
Roasted	<i>Rhizopus stolonifer</i>	80
	<i>Penicillium italicum</i>	20

### Conclusion

Boiling and roasting impacted some chemical changes in the proximate and mineral content of groundnut seeds as well as the fungal load. Boiling has shown to reduced the energy per kilo calorie which is of health benefit to weight watchers and also for cardiovascular purposes, as boiling preserve the phytochemicals in nuts than any other processing methods

### REFERENCES

- Abdel Rahman, A. H. Y. (1982): "Changes in Chemical Composition of peanut during development and ripening". *Rivista Italiana Delle Sostanze Grasse*. 59(6): 285-286.
- Adeparusi E.O.(2001): Effect of processing on the nutrients and anti- nutrients of lima bean (*Phaseolus lunatus* L.) flour *Nahrung/Food* 45 No 2, pp94-96.
- AOAC (1990): Official Methods of Analysis, 15<sup>th</sup> edition. Association of Official Analytical Chemists, Washington D. C.
- Asibuo, J. Y., Arkromah, R; Safo-Kantanka O; Adu-Dapaah, H. K. (2008): "Evaluation of nutritional quality of groundnut (*Arachis hypogaea* L) from Ghana, afr". *J. Food Agriculture Nutrition and Development* Vol. 8, No. 2.
- Atasie V. N, Akinhanmi, T. F. and Ojiodu, C. C. (2009): "Proximate analysis and physicochemical properties of groundnut (*Arachis hypogaea* L)". *Pak. J. Nutr.* 8(2): 194-197.
- Ayoola, P. B. and Adeyeye A. (2010): "Effect of Heating on the Chemical Composition and Physico-chemical Properties of *Arachis hypogaea* (Groundnut) seed flour and oil". *Pakistan Journal of Nutrition* 9(8):751-754.
- Bamburg, J.R., Strong, F.W. and Smalley, E.B (1969): "Toxins from Mouldy cereals". *J. Agric and Food chem.* 17: 443-450.
- Cheesbrough, M.J (1991). *Medical Laboratory Manual for Tropical countries*, vol 11. Microbiology Tropical Health Technology and Butterwerth Scientific publication, Boston, pp: 167-214

- Chuku, E.C, Osakwe, J.A, Munonye, I.N.C and Eke, J (2009): "Mould Growth on rice (*Oryza sativa*) as influenced by brand". International Journal of Agriculture, vol 1(2) pp 10 -12.
- Cole, R.J and Cox, R.H (1981): Hand book of Toxic Fungal Metabolites, Academic press New York.
- Derise, N. L; Lau, H. A. and Ritchie, S. J. (1974): "Proximate composition and mineral element content of three cultivars of raw and roasted peanut." J. Food Sci, 39:264-255.
- Ferrao, J. E. M. Ferro, A. M. B. C. and Antures, A. M.G. (1987): "Bambara groundnut (*Vigna subterranean*) Aspect of its nutritive value." Gracia deorta seriede Estudos Agronomicos 14:35-39.
- Jannifer. K; (2009): The Vital importance of Mineral for our health. In [www.selfgrowth.com](http://www.selfgrowth.com)
- Jimoh W.A; Fagbenro O.A and Adeparusi E.O (2011); "Effect of processing on some minerals, anti-nutrients and nutritional composition of sesame (*Sesamum indicum*) seed meals." Electronic Journal of Environmental, Agricultural and Food Chemistry. 10 (1) pp1858-1864
- Koehlar, P. and Mason, M. E. and Newell, J. A. (1969): "Formation of Pyrazine Compounds in sugar –amino acid model system J. Agric. Food Chem. 17:393-396."
- Okaka, J. C. (2005): Handling, Storage and Processing of Plant foods
- Olds, R. K (1983): A colour Atlas of Microbiology. 5<sup>th</sup> Edition. Wolf Medical Publication Ltd London.
- Onyeike, E. N. and Oguike, J. U. (2003): "Influence of heat processing methods on the nutrient composition and lipid characterization of groundnut (*Arachis hypogaea*) seed pastes". Nig. Soc. Experimental Biol. Biokemistri 15 (1): 34-43.
- Onyenuga, V. A. (1968): Nigeria's Food and Feeding Stuffs. Their Chemistry and Nutritive Value. 3<sup>rd</sup> Ibadan University Press.
- Osborne, D. R. and Voogt, P. (1978): The analysis of Nutrients in Foods. Academic Press, London: PP 166-182.
- Peanuts at the Worlds Healthiest Food Retrieved on 2007-11-08. <http://www.ask.com>.
- Peanuts: Wikipedia the free encyclopedia.
- Pomeranz, Y. and Meloan, C. E. (1987): Food Analysis: Theory and practice. 2<sup>nd</sup> edition Van Nostrand Reinhold, New York, USA, PP. 581-765.
- Savage, G. P. and Keenan, J. I. (1994): The Composition and nutritive value of groundnut kernels. In: Smart J. (ed). The Groundnut Crop: Scientific basis for improvement. London: Champman and Hall, PP. 173-213.
- Sellscope, J. P. F. (1962): Cowpea (*Vigna unguiculata* L Walp). Field Crop Abstract 15:259-266.
- Steel, R. G. and Torrie J. H. (1981): Principles and Procedures of Statistics. A biomedical approach, 2<sup>nd</sup> ed; M. C. Graw-Hill International, Auckland, P. 50-110.
- Woodroof J. G; (1983): Peanuts Production, Processing, products. 3<sup>rd</sup> edition, Avi Publishing Compnay Inc: Westport, Connecticut. P. 6.