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Effect of Heating on the Chemical Composition and Physico - Chemical Properties of *Arachis hypogea* (Groundnut) Seed Flour and Oil

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Abstract: Groundnut (*Arachis hypogea*) seeds (raw, sun-dried and roasted) were analyzed for proximate composition and some nutritionally valuable minerals. The oil extracted from the samples was subjected to physico-chemical analysis. The results showed that the raw, sun-dried and roasted seeds contained 46.10%, 43.80%, 40.60% fat, 24.70%, 21.80%, 18.40% crude protein, 17.41%, 27.19%, 36.11% carbohydrate, 7.48%, 3.40%, 1.07% Moisture, 2.83%,2.43%,2.41% crude fibre and 1.48%,1.38%,1.41% ash respectively. There was a general decrease in the proximate composition after exposure to different heating methods but there was variation in the mineral contents of the seeds after heating. Minerals included; sodium (0.71%, 0.69%, 0.57%), phosphorus (0.68%, 0.65%, 0.69%). potassium (0.47%, 0.51%, 0.55%), zinc (0.44%, 0.42%, 0.50%), Iron (0.40%, 0.47%, 0.43%). The physico-chemical properties showed; saponification values of the raw, sun-dried and roasted groundnut oil, 201,195 and 170mg/kOH/g respectively. iodine value, 110.7, 108.5, 100.7 wijs, free fatty acid 1.180, 0.891, 1.260g/100g, acid value 2.35,1.79, 2.52mg/kOH/g, peroxide value 0.740, 0.603, 0.470 meq/ kOH, refractive index 0.247, 0.256, 0.147. The roasted groundnut can be considered as a good source of valuable minerals, while the raw groundnut is a good source of protein with high nutrition value.

Key words: *Arachis hypogea*l, seed flour, heating effect, chemical composition, therapeutic properties

INTRODUCTION

Groundnuts (*Arachis hypogea*) or peanut is a legume which is widely grown as a food crop. It is an annual crop principally for its edible oil and protein rich kernel seeds, borne in pods which develop and mature below the soil surface. The groundnut is an herbaceous plant of which there are many varieties, some of which are Boro light, Boro red, Ela , Mokwa, Guta and campala. The fatty acids and physico-chemical analysis of the oils of the varieties had been investigated (Anyasor *et al.,* 2009).

Edible oils from plant sources are of interest in various food and application industries. They provide characteristic flavours and textures to foods as integral diet components (Odoemelam, 2005) and can also serve as a source of oleo chemicals (Morrison *et al.,* 1995). Oleo chemicals are completely biodegradable and so could replace a number of petrochemicals. In Nigeria, 1917 tons of peanuts are being produced annually (Ergul, 1988). Vegetable oils had made an important contribution to the diet in many countries, serving as a good source of protein, lipid and fatty acids for human nutrition including the repair of worn-out tissues, new cells formation as well as a useful source of energy (Gaydon *et al*., 1983; Grosso and Guzman, 1995; Grosso *et al*., 1997; 1999).

Beside income for farmers, groundnut provides an inexpensive source of high quality dietary protein and oil. The vast food preparations incorporating groundnut to improve the protein level have helped in no small way in reducing malnutrition in the developing countries. The special taste and flavour of foods containing groundnut is important in the acceptance of these food preparations (Asibuo *et al.*, 2008) .The quality of the oil and groundnut products depends to a large extend on the oil fraction. The oil content of groundnut differs in quantity, the relative proportion of fatty acids, geographical location , seasons and growing conditions (Adeyeye and Ajewole, 1992). Groundnut seed contains 44 to 56% oil and 22 - 30 % protein on a dry seed basis and is a rich source of minerals (phosphorus, calcium, magnesium and potassium) and vitamins E, K, and B group (Savage and Keenan, 1994).

Groundnut protein is increasingly becoming important as food and feed sources, especially in developing countries where protein from animal sources are not within the means of the majority of the populace. The seed has several uses as whole seed or processed to make peanut butter, oil soups, stews and other products. Groundnut provides considerable amount s of mineral elements to supplement the dietary requirements of humans and farm animals (Asibuo *et al.*, 2008). Groundnut seeds are reported to contain

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9.5-19.0% total carbohydrates as both soluble and insoluble carbohydrate (Croker and Barton, 1957; Oke 1967; Woodroof, 1983).

The chemical composition of groundnut seeds has been evaluated in relation to protein level (Young and Hammons, 1973), amino acid composition (Young and Hammons, 1973) and fatty acid composition (Grosso and Guznam, 1993) in several countries. Groundnut is an example of vegetable protein (David, 1987) which is used in natural health care as source of proteins in balance diet. With the increase of fake drugs in many developing countries people are encouraged to eat natural products such as fruits and vegetables. Therefore, there is need to investigate the form in which most of these products should be consumed in order to conserve the proximate, mineral and fatty acid composition for the different purposes they are meant for, such as therapeutic, prophylactic and commercial (Elizabeth, 1994). It is common knowledge that in Nigeria roasted plantain, and groundnut are good for men. The roasted groundnut is particularly good. Health is the individual responsibility. We should ensure that we eat so much of the natural food items and eat them in their natural form where possible. If cooked, they should not be over-cooked as the sensitive minerals and vitamins are easily destroyed by heat. (Elizabeth, 1994). This study seeks to investigate the effect of heat on the proximate, mineral and fatty acid compositions of groundnut.

MATERIALS AND METHODS

Sample collection and preparation: Groundnuts (*Arachis hypogea*) were purchased from Araada market, Ogbomoso, Oyo State, Nigeria and was transported in a polythene bag to the laboratory. It was divided into three: one part was sun-dried for seven days, second part was roasted and the third part was air-dried for seven days. Portion (1kg) of each sample was oven dried at 100-105^{o}C, the red skins were removed, squeezed with hand, cracked into small pieces, placed in an air tight bottle and stored in the desiccators for analysis.

Proximate analysis: Moisture content was determined by drying to constant weight at 100 -107^{o}C in an Oven, ash content by Ignition at 550^{o}C in a muffle furnace for 4hr, oil content by Soxhlet extraction with hexane as solvent , protein by the kjeldahl method, and crude fibre by the acid and alkaline digestive methods all described by Lees (1975). The carbohydrate content was estimated by difference, subtracting the sum of water, protein fat, crude fibre and ash percentages from one hundred.

Oil analysis: Peroxide value was evaluated according to AOAC (1990). The saponification value was determined according to the titre metric method of Pearson (1981). Iodine value was determined according to wij"s method of Pearson (1970). Acid value was determined by titre metric method of Pearson (1970).

Minerals: The mineral contents were determined by digesting the ash with 3M hydrochloric acid and using the atomic absorption spectrophotometer for magnesium, zinc, iron and the flame photometer for potassium, sodium, calcium and phosphorus (Pearson, 1981).

RESULTS AND DISCUSSION

Based on the results of the proximate composition of the groundnut as shown in Table 1, the moisture content ranged from 1.07-7.48%, ash content 1.38-1.48%, crude fibre 2.41-2.83%, crude protein 18.40 -24.70%, dried matter 92.52-98.93%, oil content 40.60- 46.10% and carbohydrate (by difference) 17.41%, 27.19%, 36.11% respectively.

Table 1: Proximate composition and mineral contents of the groundnut samples

	Groundnut		
Compositions	Raw % dry weight	Sun-dried % dry weight	Roasted % dry weight
Moisture content	7.48	3.40	1.07
Ash content	1.48	1.38	1.41
Crude fibre	2.83	2.43	2.41
Oil content	46.10	43.80	40.60
Crude protein	24.70	21.80	18.40
Carbohydrate	17.41	27.19	36.11

Results are means of three determinations

Table 2: Mineral composition of the groundnut on dry weight basis

Mineral	Raw groundnut	Sun-dried groundnut	Roasted groundnut
	(%)		
Sodium (Na)	0.71	0.69	0.57
Potassium (k)	0.47	0.51	0.55
Calcium (Ca)	1.18	1.24	1.35
Magnesium (Mg)	0.18	0.21	0.24
Iron (Fe)	0.40	0.47	0.47
Zinc (Zn)	0.44	0.42	0.50
Phosphorus (P)	0.68	0.65	0.69

Results are means of three determinations

The protein, ash and crude fibre contents were similar to the reports of Nelson and Carlos (1980). The average crude fibre contents in this result indicate the ability of groundnut to maintain internal distension for a normal peristaltic movement of the intestinal tract: a physiological role which crude fibre plays. Diet low in crude fibre is undesirable and may cause constipation and that such diet have been associated with diseases of colon like piles appendicitis and cancer. This study shows that raw groundnut is more advantageous in nutritional value than roasted groundnut, while the

Table 3: Chemical analysis of the raw and the heat treated groundnut oil

Parameter	Unit	Raw groundnut	Sun-dried groundnut oil	Roasted groundnut oil
Saponification value	Mg/KOH/g	201	195	170
Acid value	Mg/KOH/g	2.35	1.79	2.52
Iodine value	Wij's	110.7	108.5	100.7
Peroxide value	Meq/KOH	0.740	0.603	0.470
Refractive Index		0.247	0.256	0.147
Free fatty acid	g/100 g FFA	1.180	0.891	1.260

roasted one, is also advantageous in mineral contents than the raw groundnut.

Raw groundnut showed a good source of sodium, the sun-dried groundnut is a good source of magnesium and iron while the roasted groundnut is a good source of potassium, calcium, zinc and phosphorus.

The good availability of calcium, magnesium, phosphorus is a good indication that the groundnut is so rich in the minerals for bone formation. Calcium is very essential in blood clotting, muscles contraction and in certain enzymes in metabolic processes.

The moisture content of the raw groundnut was higher than the sun-dried and roasted because the raw groundnut was not previously exposed to any heat. The ash content of both the raw and roasted groundnuts were higher than the sun-dried because the sun-heat which normally contain UV-ray can easily react with some of the volatile compounds of the groundnut. The crude fibre of the raw groundnut was higher since no chemical reaction which can alter the composition was initiated. The oil was higher in raw groundnut while in both the sun-dried and roasted groundnut, the heat, depending on the intensity would have affected the quantity of oil.

The proximate compositions of the groundnuts were affected by heat and this explained why the moisture content, ash , crude fibre, extracted oil and crude protein of the raw sample were higher than those of the groundnut subjected to heat treatment. The carbohydrate content was higher in the roasted and the sun-dried than in the raw groundnut. Carbohydrate content ranging from 6.0 - 24.9% was reported by Duke (1981) in groundnut. Thus, in comparison with raw and sun-dried samples, roasted groundnut showed a general increase in mineral contents, especially in potassium, calcium, magnesium, zinc and phosphorus, and agrees with the observation of Derise *et al*. (1974) that roasted groundnut does not lead to reduction in the levels of mineral elements but rather increases the levels since volatile compounds are lost through heating (Table 2).

Table 3 shows the physico-chemical properties of groundnut oil. The saponification value ranged from 170 to 201 agreed with Pearson's (1981), 187 to 196mgkOH/g. Denniston *et al*. (2004) reported that high saponification value indicated the presence of greater number of ester bonds, suggesting that the fat molecules were intact. These properties make it useful in soap making industry, it is not attractive as a raw material because of its economic and nutritive implications Similarly, acid value of the roasted groundnut was relatively higher than the other two samples. According to Demian (1990), acid values are used to measure the extent which glyceride in the oil has been decomposed by lipase and other actions such as light and heat. The determination is often used as a general indication of the condition and edibility of oil. The iodine value reduced from raw groundnut (110.7) to the roasted groundnut oil (100.7) this indicates low degree of unsaturation and classified the oil as non-drying is recorded for most edible oil, Pearson (1981).

The peroxide values of all the oil samples were less than the standard peroxide value ($10mEqKg^{-1}$) for vegetable oil deterioration. Fresh oils have value less than $10mEq\ Kg^{-1}$ and value between 20 and $40mEqKg^{-1}$ results in rancid taste (Akubugwo and Ugbogu, 2007). The low peroxide value indicated slow oxidation of these oils according to Demian (1990), the peroxide formation is slow at first during an induction period that may vary from a few weeks to several months according to the particular oil and temperature(Pearson, 1981).There was no rancidity of oil samples in the course of this study the low peroxide value (0.44-0.74) Meq/KOH, indicate that the oil, especially the roasted groundnut oil can resist lipolytic hydrolysis and oxidative deterioration. The refractive index (0.147-0.247) shows that the oils contained some double bonds in its fatty acid (Eromosele and Pascal 2003), and that refractive index increases as the double bond increases. The free fatty acid ranged from 1.24 to 1.26g/100g, it is an indication of the percentage of fatty acid present in the oil and that the oil may likely undergo oxidation. This study indicated that groundnut should be treated differently for different purposes, all the groundnut oils may have a shelf- life, nutritional value, medicinal value and industrial applications.

Conclusion: Groundnut seed flour and oil can be use for different purposes such as nutritional, medicinal and industrial, only, if correctly treated and selected. For nutritional and industrial uses raw groundnuts are the best. For medicinal use either therapeutic (treatment of diseases) or prophylactic (prevention of diseases) roasted groundnuts are advisable, especially, for fertility in man, since roasting does not lead to reduction in the levels of the mineral elements but rather increases the levels, therefore, groundnut is a good source of oil,

protein and minerals which can be used in diets to prevent against some mineral deficiencies. This will aid to fight against malnutrition, leading to better nutrition and health in Nigeria and Africa as a whole.

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