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Effect of Roasting On Proximate Composition and Anti-Nutritional Content of Skinned and Unskinned Roasted Groundnut (*Arachishypogeae*) Varieties in Nigeria

*****Ukwo, P. S, Ntukidem, V. E. andUdoh, I. E.
Department of Food Science and Technology, Faculty of Agriculture,
University of Uyo, Uyo. Nigeria
Corresponding Author: Ukwo, P. S.

Abstract:*This study was conducted to investigate the proximate and Anti-nutritional properties of three selected varieties of skinned and unskinned roasted groundnut varieties (Samnut-10,22 and 23). Result of proximate composition showed significant difference (P<0.05) among the samples. The moisture content of the raw groundnut samples was significantly higher than that of the processed samples. The results for proximate composition of the roasted skinned and unskinned groundnut varieties were significantly different (P<0.05) for carbohydrate, lipid, fibre, protein, ash and caloric value. No significant difference (P<0.05) was obtained in moisture content of the skinned and unskinned roasted groundnut. The result of anti-nutritional factors of raw groundnut varieties analyzed showed that tannin and saponin levels were higher in Samnut-23 and lower in Samnut-22. However, phytic acid and oxalate levels were higher in Samnut-10 and Samnut-22, and lowest in Samnut-23. The alkaloid content in percentage was in the order of Samnut-22>Samnut-10>Samnut-23 for the raw samples. However, anti-nutrient levels significantly (P<0.05) decreased in the roasted groundnut when compared with raw groundnut varieties. The levels of anti-nutrients in the varieties analyzed were all within acceptable levels. The result indicated that roasting enhanced the quality of groundnut by significantly decreasing the levels of anti-nutrients when compared with the unprocessed sample.*

Keywords:*Anti-nutrient, Groundnut, Roasting, Skinned andUnskinned*

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I. Introduction

Foods of plant origin constitute the major source of food for human due to their availability, low cost and contribute to quality nutrition [1]. In order to have a healthy population that can promotes development, the relationship between food nutrition and health should be reinforced. One of the ways of achieving this is through exploitation of available local resources in order to satisfy the needs of the increasing population [2]. Groundnut is a major crop grown in the arid and semi-arid regions of the world, which is an ancient oil seed and fouth (4th) in oil seed crop of the world. It is an important item in several confectionery products and is supplementary feeding programmes such as in weaning food formulations in combination with cereals and pulses in many developing countries such as Nigeria [3]. Nigeria is the largest groundnut producing country in West Africa accounting for 51% of the production in the region. The country produces 10% and 39% of the world and Africa's total production respectively [4]. In the period between 1956 and 1967, groundnut including its cake and oil accounted for about 70 percent of Nigeria's total export earning and created the legendary groundnut pyramids, which dotted the landscape of Kano [5]. In Nigeria, the processing of groundnut into various products is mostly done for home consumption or for commercial purposes, the most common commercial products of groundnut include groundnut oil and groundnut cake. Also, processing of groundnut is both the source of income and employment to a large proportion of rural people in mostly Northern Nigeria.

Groundnut seeds (kernel) contained 40-50% fat, 20-50% protein and 10-20% carbohydrates [3]. It also rich sources of Vitamin E, Naicin, Folacin, Calcium, phosphorus, magnesium, zinc, iron, riboflavin, Thiamine and potassium [3]. Groundnut kernels are consumed directly as law, roasted, boiled kernels, and it oil can be used for culinary purposes. The use of groundnut plant makes it an excellent cash crop for domestic markets as foreign trade in several developing and developed countries [3]. Furthermore, groundnut have an abundant amount of natural antioxidant such as resveratrol, with groundnut skin having the highest antioxidant levels compared to other parts of groundnut [6]. Like other legumes, groundnut contains antinutrients like tannins, trypsin inhibitors, saponnins, alkaloids, oxalates phytates and cyanogenic glycosides, which reduce the limits, the nutrient utilization present in groundnut.

In Nigeria, groundnut is processed through various techniques such as boiling, roasting and frying. Roasting imparts the typical flavour to peanut, which can be achieved by dry roasting or oil roasting. During roasting, amino acid and carbohydrates react to produce tetrahydro-furan derivatives. Roasted groundnuts can either be consumed skinned or unskinned depending on one’s choice. This study is aimed at determining the nutritional and anti-nutritional composition of both skinned and unskinned roasted groundnut varieties and also enlightened the consumers on which is suitable or best for consumption.

II. Materials and Methods

2.1 Sample Collection: A total of three varieties of raw fresh samples of groundnuts (Samnut-10,22 and 23) were purchased from Itam market in Itu Local Government Area and were taken to Crop Science Department, University of Uyo, for identification. The equipment and reagents used for the analysis were obtained from Department of Food Science and Technology Laboratory and Biochemistry Laboratory respectively, University of Uyo, Uyo.

2.2 Sample Preparation: The three (3) varieties of groundnut obtained from the market were sorted and weighed (1kg) each of the variety and wash with one (1) litre of distilled water to remove surface dirt and impurities and divided into two (2) equal portion each.The first portion was processed by roasting and the second portion was unprocessed (raw).

2.3 **Roasting:** According to the method, outlined by Alicia [7]. About 500grams of groundnut samples was salted by dissolving 2 grams of edible salt into 1 litreof distilled water. The water was drained off, while the groundnut was spread-dried in sunlight. The dried salt groundnut was then roasted in a pre-heated oven at 150^0Cfor 15 minutes, the samples were then allowed to cool. The roasted samples were further divided into two (2) equal portions. The first portion with the skin still attached to the seed (unskinned) and the other where skinned. All the samples were then pulverized separately using hand attrition mill (mode MX 491, National) to get smaller particle size.

2.4 Methods of Analysis

2.4.1 Determination of Proximate composition of the samples: Proximate analysis including: moisture content, ash, crude fiber, crude protein, crude fat, carbohydrate and energy were carried out on the ground groundnut samples using standard methods described by the Association of Official Analytical Chemists, AOAC [7]. The determinations were done in triplicates and all reagents used for the analysis were of analytical grade.

2.4.2 Determination of Anti-nutrients:Phytateand Oxalate were determined following the method described by Onwuka [17]. Tannin, Saponin and Alkaloid were determined following the method described in AOAC [7].

2.4.3 Statistical Analysis: Statistical Package for Social Science (SPSS, version 20) was used for the statistical analysis. The differences between samples in each parameter tested was done using One Way Analysis of Variance (ANOVA) and New Duncan’s Multiple Range Test as a post-hoc test when the analysis of variance indicates significant difference in their means. A significant level of P<0.05 was used throughout the study.

III. Results and Discussion

3.1 Proximate Composition

The proximate composition of the groundnut varieties as shown in Table 1, indicated a significant difference (P<0.05) among the raw and roasted groundnut samples. The raw groundnut has the highest moisture content ranging from 4.70% to 5.08% when compared with the roasted groundnut that ranged from 2.62% to 3.45%. This result suggests that the moisture available in the raw samples may have reduced by the heat applied during roasting. This result is in agreement with the one obtained from Musa *et al.*, [9]; Eugene and Juliana, [10]. Since moisture content affects the physical and chemical aspect of food, which relates with freshness and stability for the storage of food for a longer period of time [9].

However, among the raw varieties analyzed, there was a significant difference (P<0.05), Samnut-10 had the highest moisture content of 5.08% and Samnut-22 had the least moisture content of 4.62%. In the roasted varieties RSK 10 (34.5%) was higher in moisture content than that others, with RUSK 23 having the lowest (2.62%). Furthermore, it was observed that, there was no significant difference (P<0.05) in moisture content among the skinned and the unskinned groundnut. The moisture content of the groundnut varieties were within the maximum level of 10% approved by Codex Alimentarius Commission – International Food Standard.

Ash content is an indication of the total amount of minerals present in the food sample. Ash content was significantly different (P<0.05) in all the groundnut varieties analyzed. Sample Samnut-22 had the highest ash content of 4.00% followed by sample Samnut-23 (3.99%) while Samnut-10 had the least ash content of (3.68%). The roasted samples had ash content within the range of (1.17 to 2.95%), since ash is the inorganic reduce that remains after water has been removed by heating the present of oxidizing agent, which provides a measure of total minerals within a food. It implies that Samnut-23 has greater inorganic and minerals content than other varieties. It was observed that ash content decreased after roasting, which is in agreement with the work of Musa *et al.,* [9];Ayoola and Adeyeye, [11]. This could be because during processing, some of these inorganic components may have leached out of the seed and as such some of the inorganic components were lost.

The result obtained for crude fibre was significantly different (p<0.05) among the varieties. Samnut- 23 had the highest crude fibre content of 3.06%. However, when comparing the skinned and the unskinned, fibre was significantly different (P0.05) with RUSK 10 having the highest (6.73%) while RSK 23 having the lowest value of 1.01%. This result is in line with the work of Iftikhar and Khan [12]. It was observed that crude fibre increased in all the roasted varieties after roasting and there was a decrease in fibre content of the roasted skinned groundnuts in all the varieties. This is in agreement with work of Mada*et al.,* [13]. The result revealed that the organic indigestible content is higher in Samnut-23 than other varieties, and also higher in unskinned than the skinned roasted groundnut seed since crude fibre measures other components present in food [14]. Diet low in crude fibre is undesirable and may cause constipation and such diet may be associated with diseases like pile, appendicitis and cancer.

The value of crude protein for the groundnut varieties analyzed are significant different (P<0.05) having 21.24%, 22.48% and 27.85% for Samnut-22, Samnut-23 and Samnut -10 respectively. The relative high protein content (16.90-27.85%) observed among the raw sample is an indication that these groundnut varieties can be of value in man and animal diet, particularly in developing countries where the cost of conventional protein sources are expensive. Moreso, the protein content in the raw groundnut is capable to significantly contribute to the daily protein requirements of humans, which is about 15-56% [3]. However, after roasting the crude protein decreased in all the varieties which is in agreement with the result reported by Mada*et al.,* [13]. It therefore means that, during roasting, the applied heat has raised the temperature above 37^0C and therefore caused denaturation of the protein.

The values of lipid obtained for raw samples are significantly different (P<0.05) among the varieties, Samnut-22 having the highest lipid content of 51.28% than samnut-23 51.00% and Samnut-10 with 47.02%. However, when compared with the roasted samples, that range from (49.33% to 63.36%), it was observed that there was an increase lipid content after roasting except for sample RUSK 23 that was reducing. The high lipid content is because groundnut is a very rich source of lipid. This result was in agreement with work of Musa *et al*., [9]. This also explains why roasted groundnut is mostly used for oil extraction. There was a significant difference (P<0.05) in skinned than the unskinned groundnut seeds.

The data for carbohydrate content as presented in Table 1 reveals that raw groundnut varieties are significantly different (P<0.05) among the varieties, ranging from 14.49 to 16.58% with Samnut-10 having the least and Samnut-22 having the highest carbohydrate content respectively. Also, a relatively high carbohydrate content of the raw samples (14.49-16.58%) was observed in the raw groundnut varieties when compared to other sources of protein from cow, milk and egg. From the Table, carbohydrate content was higher in the skinned groundnut samples with RSK 23 having the highest content of 22.46% and RUSK 22 having the least value of 11.42%. This result agrees with the work of Iftikhar and Khan [12]. After roasting, it was observed that carbohydrate contents of sample RSK 10 and RUSK 10 decreased when compared with Samnut-10. Similar observation was observed with samples RSK and RUSK 22 when camporee with Samnut-22. But, there was an increase in skinned and unskinned Samnut-23. This implies that the bioavailabilty of carbohydrate molecules in RSK 23 and RUSK 23 increased during processing (roasting) of the Samnut- 23 and this is in agreement with the work of Nwaogu and Udebuani [15].

From the result obtained, there was a significant difference (P<0.05) in the caloric value of the groundnut varieties analyzed. Sample Samnut-10 had the least value (594.57kcal/100g) while Samnut-22 had the highest caloric value of 611.12kcal/100g. The result is also in agreement with the work of Mada*et al.,*[13]. However, when comparing the skinned and unskinned roasted groundnut, the caloric values slightly increased in RSK 10 (605.04 Kcal/100g) than RUSK10 (604.79 Kcal/100g), same was observed with RSK 23 (651.30kcal/100g) and RSK 23 (603.34kcal/kg). It's decreased in RSK 22 (659.22 Kcal/100g) when compared with RUSK 22 (683.60 Kcal/100g). It implies that more energy is derived from consuming skinned groundnut than the unskinned roasted groundnuts.

Table1: Proximate Composition of Groundnut Samples

	Moisture (%)	Ash (%)	Fibre (%)	Protein (%)	Lipid (%)	CHO (%)	CaloricValue (Kcal/100g)
Samnut-10	5.08 ± 0.15^{a}	3.68 ± 0.17^{b}	2.04 ± 0.06^{b}	27.85 ± 0.06^{a}	47.02 ± 0.07^{b}	14.49 ± 0.49^{b}	594.57 ± 0.70^{b}
RSK 10	3.45 ± 0.01^{a}	1.17 ± 0.02^{d}	6.34 ± 0.00^{b}	24.66 ± 0.24^{b}	50.21 ± 0.01^{d}	13.61 ± 0.01^{c}	605.04 ± 0.88^{c}
RUSK 10	3.43 ± 0.06^{a}	2.28 ± 0.02^{b}	6.73 ± 0.01^{a}	25.20 ± 0.02^{a}	50.03 ± 0.06^{d}	13.42 ± 0.04^{c}	604 ± 0.40^{c}
Samnut-22	4.62 ± 0.03^{b}	4.00 ± 0.03^{a}	2.47 ± 0.58^{ab}	21.24 ± 0.29^{c}	51.23 ± 1.08^{a}	16.58 ± 1.13^{a}	611.12 ± 5.72^{a}
RSK 22	3.09 ± 0.06^{b}	1.71 ± 0.06^{d}	2.76 ± 0.04^{d}	16.90 ± 0.00^{f}	58.00 ± 0.00^{b}	16.45 ± 0.03^{b}	659.22 ± 0.16^{b}
RUSK 22	3.02 ± 0.09^{b}	2.05 ± 0.01^{c}	3.18 ± 0.02^{c}	18.14 ± 0.10^{d}	63.36 ± 0.04^{a}	1.42 ± 0.84^{d}	683.60 ± 2.79^{a}
Samnut-23	4.70 ± 0.02^{b}	3.99 ± 0.02^{a}	3.06 ± 0.12^{a}	22.4 ± 0.45^{b}	51.00 ± 0.00^{a}	15.14 ± 0.97^{ab}	609.52 ± 2.24^{a}
RSK 23	2.70 ± 0.01^{c}	1.75 ± 0.06^{d}	1.01 ± 0.07^{f}	17.75 ± 0.06^{e}	54.50 ± 0.01^{c}	22.46 ± 1.06^{a}	651.30 ± 4.10^{b}
RUSK23	2.62 ± 0.01^{c}	2.95 ± 0.01^{a}	2.12 ± 0.09^{e}	18.71 ± 0.08^{c}	49.33 ± 1.94^{d}	21.0 ± 1.41^{a}	603.34 ± 23.17^{c}

Data are mean values $\pm$ Standard deviation of triplicate determination. The mean values in the same column with different superscript are significant different at $P<0.05$

Key:

Samunt-10 (Raw Groundnut Variety), RSK 10 (Roasted Samnut-10 Skinned), RUSK 10 (Roasted Samnut-10 Unskinned), Samnut-22 (Raw Groundnut Variety), RSK 22 (Roasted Samnut-22 Skinned), RUSK 22 (Roasted Samnut-22 Unskinned), Samnut-23 (Raw Groundnut Variety), RSK 23 (Roasted Samnut-23 Skinned), RUSK 23 (Roasted Samnut-23 Unskinned)

3.2 Anti-nutritional Composition

The present investigation revealed that among the varieties, Samnut-10 has the highest phytate content of 1.34mg/100g while Samnut-23 had the least phytate content of 1.15mg/100g. The phytic acid content of the range1.15 to 1.34mg/100g obtained for these groundnut varieties is lower than the value reported by Omilikhoje*et al.,* [16] for raw Bambara groundnuts. This result also revealed that phytate level of the groundnut samples pose no health risk as it is within its lethal dosage. The lethal dose of phytate in food crops is 50-60g/kg [17]. The raw groundnut analyzed (1.15-1.34mg/100g) contained more phytate than the roasted groundnut (0.314mg/100gto 1.17m/100g). By implication it means, during processing (roasting) the phytic acids are inactivated by heat, which appears to be in agreement with report of Akinyele [18] However, the unskinned groundnut have higher phytate contents than the skinned, with RUSK 10 having the highest phytate level of 1.173mg/100g and RSK 10 having the least value of 0.314mg/100g over a long period deceases the bioavailability of mineral elements in monogastric animals. Phytateis known to binds to elements such as calcium, zinc, manganese, iron and magnesium to form complexes that are indigestible, thereby decreasing the bioavailability of these elements for absorption.

Oxalate was significantly different ($P<0.05$) among the varieties. The values 1.17mg/100g, 1.44mg/100g and 1.73mg/100g for Samnut 10, Samnut 22 and Samnut 23 respectively.Oxalate levels in the roasted groundnut (0.85mg/100g to 1.64mg/100g) was significantly different ($P<0.05$) from the raw groundnut (1.17mg/100g to 1.73mg/100g) which supports the claim that processing improves nutrient potentials of leguminous seeds by reducing the level of anti-nutritional factors. Based on the result obtained, the value of oxalate levels of raw and roasted groundnut samples were found to be higher than the values reported by Mada*et al.,* [13] for groundnut, but collaborates with his report on roasted groundnuts which had lowest oxalate when compared to the raw groundnuts. According to Ladeji [19], oxalate can bind to calcium present in food thereby rendering calcium unavailable for normal physiological and biochemical role such as maintenance of strong bone, teeth, cofactor in enzyme reaction, nerve impulse transmission and as clotting factor in the blood. However, the results obtained revealed that oxalate levels slightly decreased in the skinned groundnut (0.85mg/100g to 1.33mg/100g) ($P<0.05$) when compared to the skinned groundnut (1.06mg/100mg) to (1.64mg/100g) with RUSK 22 (91.64mg/100g) and RSK10 (0.85mg/100g) having the highest and lowest level of oxalate. The oxalate levels of the groundnuts analyzed were below their lethal level of 2-5g/kg reported by Onwuka [17].

There was a significant difference ($P<0.05$) in the saponin levels of the groundnut analyzed with the highest value being Samnut-23 (0.52mg/100g), Samnut-10 (0.50mg/100g) and Samnut- 22(0.49mg/100g) having the lowest value. However, the saponin present in the seed decreased after roasting. This result collaborates with the work of Nwogu and Udebuani [15] and implies that heating the sample may have inactivated the saponin present in the seed. However, the saponin levels were significantly different ($p<0.05$) in the unskinned and skinned groundnut for all variables with RUSK 22 and RUSK 23 having the highest value of 0.47mg/100g and 0.47mg/100g andRSK22 and RSK23 having the lowest values of 0.42mg/100g and 0.42mg/100g respectively.

Alkaloid for raw groundnut ranges from 0.21% and 0.89% (Table 2) and is significantly different ($p<0.05$) from the values of roasted groundnut, which ranged from 0.11% to 0.86%. This is in agreement with work of Sutharsingh [20]. There was a significant difference ($p<0.05$) on the groundnut varieties analyzed, Samnut22 had higher levels of alkaloids of 0.89% and Samnut 23 had the least content of 0.21%. Whereas according to FAO, Alkaloids are not strictly regarded as anti-nutrients but are rather grouped within natural food toxicants. Most alkaloids are known for their pharmacological effects rather than for their toxicity. However, when alkaloids occur in high levels in foods, they cause gastro-intestinal upset and neurological disorders (Okaka*et al.*,[21]. Alkaloids generally act as stimulants by prolonging the action of several hormones. It was also observed that the percentage of alkaloids was higher ($p<0.05$) in the skinned groundnut (0.13%, 0.77%, 0.86%) for RSK10, RSK22 and RSK23 than the unskinned groundnut (0.11%, 0.81%, 0.53%) for RUSK10, RUSK22, and RUSK23 respectively.

Tannins have the capacity of decreasing the digestibility and palatability of proteins because they form insoluble complexes with them [22]. Tannin content was significantly different ($p<0.05$) in raw samples ranging from 2.80mg/100g to 3.44mg/100g, with Samnut-22 and Samunt-23 having the highest and lowest tannin levels respectively. However, the tannin levels slightly decreased in the roasted samples ranging from 1.931mg/100g to 3.435mg/100g and this implies that as the temperature is increased during processing, the tannin-protein complex is broken down which increases the digestibility and palatability of the seed [23]. This result is in agreement with the work reported by Nwaogu and Udebuani [15]. However, the results in table 2 revealed that tannin levels were significantly different ($p<0.05$) in the skinned and unskinned groundnut with RSK22 having the lowest value 1.931mg/100g and RUSK23 having the highest value of 3.425mg/100g.This result collaborates with the work of Omilikhoje*et al*., [16]. Aletor [24] reported that high level of tannins (76-90g/kg) could be detrimental if consumed which implies that the tannin levels content recorded is within the acceptable range. However, high tannin in diets is ascribed to its astringent property, which is a consequence of its ability to bind with proteins of saliva and mucosal membranes [25].

Table 2: Anti-Nutritional Content of Groundnut Samples

	Phytate (mg/100g)	Oxalate (mg/100g)	Saponin (mg/100g)	Alkaloid (mg/100g)	Tannins (mg/100g)
Samnut-10	1.34 ± 0.04^{a}	1.17 ± 0.03^{c}	0.50 ± 0.01^{ab}	0.80 ± 0.05^{b}	2.91 ± 0.01^{b}
RSK 10	0.314 ± 0.007^{e}	0.85 ± 0.02^{f}	0.43 ± 0.02^{b}	0.77 ± 0.01^{ab}	2.50 ± 0.016^{e}
RUSK 10	1.173 ± 0.034^{a}	1.06 ± 0.01^{e}	0.46 ± 0.02^{a}	0.53 ± 0.01^{ab}	2.787 ± 0.0
Samnut-22	1.20 ± 0.05^{b}	1.73 ± 0.02^{a}	0.49 ± 0.01^{b}	0.89 ± 0.01^{a}	2.80 ± 0.05^{c}
RSK 22	1.092 ± 0.026^{b}	1.14 ± 0.03^{d}	0.42 ± 0.01^{b}	0.86 ± 0.02^{ab}	2.724 ± 0.052^{d}
RUSK 22	1.121 ± 0.018^{b}	1.64 ± 0.03^{a}	0.47 ± 0.01^{a}	0.81 ± 0.02^{ab}	2.724 ± 0.052^{d}
Samnut-23	1.15 ± 0.02^{b}	1.44 ± 0.01^{b}	0.52 ± 0.02^{a}	0.21 ± 0.01^{c}	3.44 ± 0.02^{a}
RSK 23	0.852 ± 0.010^{d}	1.33 ± 0.06^{c}	0.42 ± 0.00^{b}	0.13 ± 0.02^{b}	2.929 ± 0.012^{b}
RUSK 23	1.029 ± 0.207^{c}	1.41 ± 0.01^{b}	0.47 ± 0.02^{a}	0.11 ± 0.97^{a}	3.425 ± 0.012^{a}

Data are mean values $\pm$ Standard deviation of triplicate determination. The mean values in the same column with different superscript are significant different at $P<0.05$

Key:

Samunt-10 (Raw Groundnut Variety), RSK 10 (Roasted Samnut-10 Skinned), RUSK 10 (Roasted Samnut-10 Unskinned), Samnut-22 (Raw Groundnut Variety), RSK 22 (Roasted Samnut-22 Skinned), RUSK 22 (Roasted Samnut-22 Unskinned), Samnut-23 (Raw Groundnut Variety), RSK 23 (Roasted Samnut-23 Skinned), RUSK 23 (Roasted Samnut-23 Unskinned)

IV. Conclusion

This study revealed that Samnut-22 has the highest nutritional and anti-nutritional content than other varieties with Samnut-10 having the least amount. Roasting decreased most of the anti-nutrients in the groundnut seeds, which supports the claim that processing improves nutrient potentials of leguminous seeds by reducing the level of anti-nutrient factors. It can also be found that the unskinned groundnut composition than the skinned roasted groundnut. Furthermore, it was found that some of the anti-nutrients instigated in the groundnut samples were within their permissible levels.

However, taking the choice of consuming roasted groundnut and human health into consideration, it may be recommended that skinned groundnut is best suitable choice for consumption due to its lower levels of anti-nutrients when compared with the unskinned roasted groundnut.

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