PHYSICOCHEMICAL PROPERTIES OF OIL AND FLOUR FROM SELECTED PEANUT VARIETIES

ABSTRACT

Physicochemical properties of oil and flour from selected peanut (*Arachis hypogaea* L.) varieties was investigated. Physicochemical, proximate and mineral properties of the oil and flour from two selected varieties (Samuel 25 and Samuel 24) were assessed following standard procedures. The result of the physicochemical parameters of peanut oil showed that refractive index, iodine value (gl/100g), specific gravity (g/cm^3), flash point (^{o}C), fire point (^{o}C), smoke point (^{o}C), cloud point (^{o}C), saponification value (mgKOH/g), % free fatty acid (%) and colour ranged between 1.11 and 1.52, 101.90 and 99.30, 0.94 and 0.92, 240.50 and 237.50, 316 and 301.50, 202.00 and 208.5, -2 and -4, 192.00 and 188.00, 31.21 and 30.71 and light brown to amber milky colour respectively. There were significant (P=.05) differences in the ash (2.28 and 2.09%), moisture (12.19 and 12.14), fat (5.00 and 5.29) and fibre (2.00 and 2.05) contents across the two samples. There were however no significant (P≥.05) differences in the protein (20.92 and 20.95) and carbohydrate (57.60 and 57.48) contents of the two varieties (Samuel 25 and Samuel 24) of peanut flours. The result of the mineral revealed that calcium, iron, potassium and sodium ranged between 26.49 and 26.31, 5.62 and 5.60, 13.99 and 13.84 and 10.37 and 9.92 mg/100g respectively for sample A and Sample B. The current study indicated that Samuel 25 peanut variety had good chemical and physical properties. Hence, its utilization in diet will give best results in combating diseases like cancer, diabetes and cardiovascular diseases based on the results indicated.

Keywords: *Peanut, Oil, Flour, Physicochemical, Proximate, Mineral*

1. INTRODUCTION

Peanuts *(Arachis hypogaea* L.), which can also be referred to as groundnuts is of the *Leguminosae* family. China is the largest producer of peanuts worldwide while Nigeria is interestingly ranked as the largest producer of peanuts in Africa. They are processed into a number of products such as oil, flour and other food products. Large number of peanut varieties grown on a global scale are utilized as food [1]. “Peanuts are good source of dietary fiber and a wide range of essential nutrients such as B group vitamins, minerals (phosphorus, calcium, magnesium, and potassium), oil (44 to 56%), antioxidants, protein (22 to 30%), carbohydrate (9.5 to 19.0%) and essential fatty acids (linoleic)” [2;3]. “Fatty acid composition of peanut plays a significant role in nutritional and storage qualities of peanuts” [4]. “Oil obtained from peanut contains both saturated and unsaturated fatty acids” [5]. “Values for Oleic acid in standard peanut varieties varies from 21 to 85% but has about 21.5% linoleic acid”. [6] investigated the physicochemical characteristics of the oil and found the specific gravity (0.915 to 0.918), the acid value (3.96 to 4.95 mg g1), the saponification value (226.40 to 246.56 mg g1), and the unsaponifiable matter (3.20 to 4.20 g/100 g). Hence, the pressing needs and interests of food processors in processing peanuts into oil, flour and other related products.

Peanut has numerous varieties. However, there are four (4) basic types which cut across Runner, Virginia, Spanish and Valencia. These peanut types are different in sizes, flavor and nutritional compositions. Also, it is worthy of knowing that Virginia varieties are the largest of the four types with premium sensory characteristics and nutritional values. Most of these varieties are used mostly for peanut candy, salted nuts, and peanut butter [7].

“Peanuts have many value-added products such as peanut oil and peanut flours that have been developed with a number of applications in bakery, confectionery, and the general consumer market. Peanut is processed into its oil by first crushing the peanuts through either hydraulic pressing, expeller pressing, or solvent extraction techniques. Oils from peanuts are classified as refined peanut oil, gourmet peanut oil, deep-frying oil of choice and 100% peanut oil. In 2008 Asia and Africa contributed 94% of the world’s peanut oil production (5.45 million tons), whereas the contribution of America was only 4%” [8].

“Peanut flours are made from raw peanuts, which have been cleaned, blanched, and electronically sorted to select the highest quality peanuts, the nuts are then roasted and naturally processed to obtain lower fat peanut flour with a strong roasted peanut flavor. Peanut flour is used in confectionery products, seasoning blends, bakery mixes, frostings, fillings, cereal bars, and nutritional bars. Peanut flour, because of its high protein content (45–50%), is a good protein source in addition to its function as a flavoring agent (APC, 2011). Peanut flour at a level of 4–8% in formulation has been found to extend the shelf life of confectionary products" [9]. "Recent studies reported the rheological, foaming, emulsifying, and water holding properties of peanut flour and declared that peanut flour as a potential additive to increase the protein contents of various food commodities especially baked goods" [10].

Demands for popular vegetable oil in Africa and Nigeria at large has been on the rise over time, as industrialists depend on the mostly available vegetable oil (palm kernel oil, soya bean oil, cotton seed oil and coconut seed oil) for preparation of various food and non-food products [11; 12]. The characteristics of oils from different varieties of peanut depend mainly on their compositions and as such no oil from a single variety can be suitable for all purposes, thus the study of their physicochemical constituents is timely, essential and absolutely necessary. Therefore, this study was geared at evaluating the physicochemical properties of oil and flour from selected varieties of peanuts.

2. MATERIAL AND METHODS

2.1 Source of Material

The peanut seeds used for this study was purchased from a retail market in Makurdi, Benue State, Nigeria. Two varieties of peanut (Samuel 24 and Samuel 25) were used for the study

2.2 Extraction of Peanut Oil and Production of Peanut Flour

Peanut oil extraction was achieved by modified method described by (17). The collected peanut seeds were manually sorted and cleaned. The seeds were roasted for 30 minutes at 120^{o}C to pave way for dehulling after which it was milled to obtain peanut whey. The whey was screw pressed and the oil extracted using petroleum ether solvent. The peanut oil was extracted and kept for physicochemical analysis while the meshed was further processed into obtaining peanut flour. The meshed left after the peanut oil has been extracted was sun-dried for approximately 72 hours after which it was pulverized and peanut flour obtained. The production of peanut oil and peanut flour is as shown in Chart 1.

2.3 Physicochemical Properties of Oil from selected Peanuts Varieties

2.3.1 Colour of oils

Method described by [14] was used to ascertain the colour of oil from the two selected peanut varieties. The oil colour was determined at room temperature (25°C).

2.3.2 Specific gravity

In determining the specific gravity of the oil from two varieties of peanut, method described by [15] was used. The specific gravity bottle was placed in a water bath maintained at 25°C and filled with distilled water. It was removed, wiped dry (outside the bottle) and weighed. The bottle was emptied, dried and again placed in water bath at 25°C. The bottle was refilled with the oil and made to stay in the water bath for 30 min. It will then be removed, cleaned and wiped (outside the bottle) completely dry and weighed. The specific gravity at 25°C was calculated as follows:

$$\text{Specific gravity at } 25/25°\text{C} = \frac{\text{weight of bottle and oil at } 25°\text{C} - \text{weig ht of bottle at } 25°\text{C}}{\text{weight of bottle at } 25°\text{C}}$$

Peanuts
↓
Cleaning by hand sorting
↓
Roasting (120 ^{o}C for 30 min)
↓
Dehulling
↓
Milling
↓

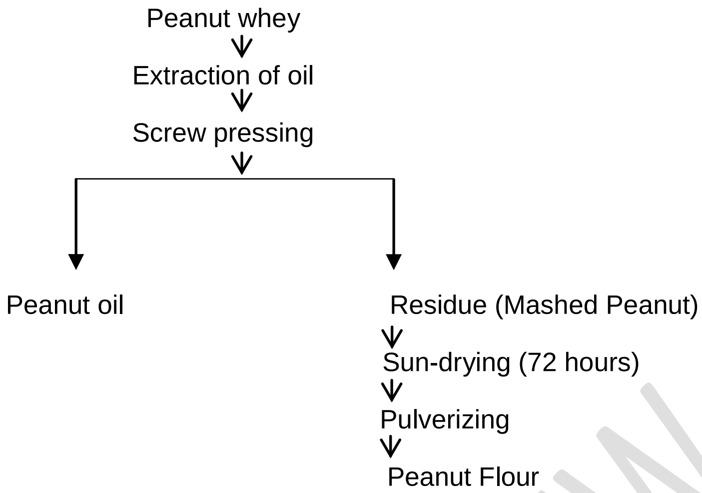

Chart 1: Flow Chart for the Extraction of Peanut Oil and Production of Peanut Flour

Source: [13] Modified

2.3.3 Refractive index

Scientific method described by [15] was used in determining refractive index of the peanut oils. Drops of oil were supplied to the measuring prism of a digital handheld refractometer and was illuminated by a light source. The prism was adjusted to the same temperature as the sample. The meter, then interprets the light transmission into refractive index.

2.3.4 Percentage free fatty acid

Isopropyl Alcohol method described by [15] was employed to determine percentage free fatty of oils from selected peanut varieties. One milliliter (1ml) of peanut oil was measured into 10ml of isopropyl alcohol and about 0.5 ml of phenolphthalein indicator was also added. This mixture was then titrated against 0.2 N sodium hydroxide (NaOH) until pale pink color appeared. The end point was noted and acid value was recorded. The percentage free fatty acid value was then calculated using the formula presented below:

$$\text{FFA (as oleic)} = \frac{V \times N \times 28.2}{W}$$

Keys; V = Volume (ml) of NaOH, N = Normality of NaOH, W = Weight of sample.

2.3.5 Iodine value

Wijs method described by [15], was used to estimate the iodine value of oil from the selected peanut varieties. 0.2g of sample was weighed into a 500 ml volumetric flask. About 15 ml carbon tetrachloride was also added. The mixture was intensely swirled for the sample to completely dissolve. 20 ml of Wij's solution was pipetted into volumetric flask containing the measured sample. The flask was stoppered and again swirled for complete mixing. The sample later placed in the dark for complete 40 min at room temperature. After the flask had been removed from storage, 20 ml of 10 % KI solution was added, followed by 150 ml distilled water. The mixture was titrated with 0.2 N sodium thiosulfate ($Na_2S_2O_3$) solution, this was gradually added with constant and vigorous shaking until the fading out of the observed yellow colour. 1.5 ml starch indicator solution was also added at this point and the titration continued until the blue colour disappeared. The iodine value was calculated using the formula presented below:

$$\text{Iodine value} = \frac{B - S \times N \times 12.69}{\text{Weight of oil}}$$

Where; B = Blank titre value, S = Sample titre value and N = Normality of $Na_2S_2O_3$.

2.3.6 Saponification value

The saponification value was determined as described by [15]. 2 g of sample was weighed into a volumetric flask. 25 ml of alcoholic solution of KOH was pipetted and allowed to drain for about 1 min into the mixture. Also, a blank determination was prepared and determined simultaneously with the sample. The mixture was subjected to heat and was allowed to boil for 1 hr. Then the materials were cooled but not sufficient to form a gel. The heat exchanger used for the study was disconnected and 1 ml of phenolphthalein indicator was added to the content of the volumetric flask. The solution was titrated with 0.5 N HCl watching out for the disappearance of pink colour. The saponification value was calculated as given in the formula below:

$$\text{Saponification value} = \frac{B - S \times 56.1 \times N}{\text{weight of oil sample}}$$

Where, B = Blank titre value, S = Sample titre value and N = Normality of HCl.

2.3.7 Flash Point

Cleveland Open Cup method described by [15] was used in determining flash points of the oils from selected peanut varieties. Samples were heated and flame above the oil surface was introduced. The temperature of the oil at which flash or ignition was recorded as the flash point.

2.4 Determination of Proximate Composition of Flour from selected Peanut Varieties

2.4.1 Moisture content determination

Hot air oven method described by [20] was used in determining moisture content of flour from selected peanut varieties. A completely empty crucible was weighed and 1g of flour sample was transferred into the crucible. This was subjected to hot air oven and dried for 24 hours at 100^0C. Loss in weight was recorded as moisture content.

2.4.2 Protein Content determination

The Kjeldahl method described by [16] was used to determine the crude protein. 1g of flour sample was emptied into the digestion tube. A catalyst weighing 0.88g (96% anhydrous sodium sulphate, 3.5% copper sulphate and 0.5% selenium dioxide) was added. Concentrated sulphuric acid (7 ml) was added and was vigorously mixed. The mixture was strongly heated and was shaken intermittently to obtain a clear mixture. The mixture was cooled and diluted with 20 ml distilled water and then 10 ml of diluted digest (8 ml of 40% NaOH) was transferred into a steam distillation apparatus. 5 ml of 2% boric acid solution was added to the receiving flask and about 3 drops of mixed indicator was added. The delivery tube was dipped into 100 ml conical flask and titrated with 0.01 hydrochloric acid (HCl). In calculating the percentage nitrogen, the formula presented below was used:

$$\%\ \text{Nitrogen} = \frac{(S-B)\times 0.0014\times 100\times D}{\text{sample weight}}$$

Where, S = sample titre, B = Blank titre, S - B = Corrected titre, D = Diluted factor
% Crude Protein = % Nitrogen x 6.25 (correction factor).

2.4.3 Crude fat determination

Soxhlet method described by [16] was used to determine the fat content of flour from selected peanut varieties. 2 g of sample was weighed into a flask (thimble). 150 ml of 40 – 60°C hexane in a 250 ml bottom flash was fitted to the Soxhlet liquid extractor. The apparatus was heated at 102^oC for 5 hours. The solvent was then recovered and the flask transferred into hot air-oven at 80^oC for 1 h to remove the residual moisture and to evaporate the solvent. It was then cooled to room temperature before weighing. Percentage fat content was calculated as provided below:

$$\%\ \text{Crude Fat} = \frac{\text{weight of extracted fat}}{\text{Weight of Sample}} \times 100$$

2.4.4 Ash content determination

Method described by [16] was used for determining ash content of samples. 2 g of sample was weighed into pre-heated crucible, it was then weighed after cooling. This process was followed by heating the crucible and content in a furnace (550°C, 6-7 h), after which the dish was cooled and weighed at room temperature. Ash content was calculated as percentage of the original sample weight as shown in the formula below:

$$\% \text{ Ash} = \frac{(W_3\text{-}W_1)}{(W_2\text{-}W_1)} \times 10$$

Where: W1 = Weight of empty crucible, W_2 = Weight of crucible + Sample before ashing, W_3 = Weight of crucible + Content after ashing.

2.4.5 Crude fiber determination

Method described by [16] was also used in determining the fibre contents of peanut flour. 2 g of sample was extracted using Diethyl ether and was digested and filtered. The obtained residue was dried at 130^{o}C for 2 hours which was succeeded by cooling and weighing. The residue was transferred into a muffle furnace and was ignited at 550^{o}C for 30 minutes, and again cooled and weighed. The percentage crude fibre content was calculated as given below:

$$\% \text{ Crude fibre } = \frac{\text{Loss in weight after incineration}}{\text{Weight of original food}} \times 100$$

2.4.6 Carbohydrate content determination

By difference method introduced by [17] was used in determining the carbohydrate content of the peanut flours from selected peanut varieties. It is calculated as presented below:

% Carbohydrate=100 -(%moisture+%Protein+%Fat+%Ash + %Fibre)

2.5 Determination Minerals Composition of Flour from Selected Peanuts Varieties

2.5.1 Calcium, iron and Potassium

Atomic Absorption Spectrophotometry described by (16) was used to determine the trace amount of calcium, iron and potassium contents of flours from peanut varieties. 1 g of sample was ashed in a muffle furnace (550°C, 5 h). calcium, iron and magnesium were determined from the ashed sample through addition of 20.0 ml of 2.5% hydrochloric acid (HCl), and was heated to reduce the volume to 7.0 ml, this was then after transferred into a 50 ml volumetric flask. It was diluted with distilled water to a 50 ml mark and was stored in sterile bottles. Thereafter, calcium, iron and potassium contents were determined using atomic absorption spectrophotometer.

2.5.2 Sodium

Method described by [16] was used in determining sodium content of the flour. 2g of sample was ashed in a preheated muffle furnace (600°C for 2 h). The ash was dissolved in 5 ml of 5 M sulfuric acid. 5 ml of 2% ascorbic acid and 5 ml of 4% ammonium molybdate was added to the resulting solution and shaken vigorously for an homogenous mixture. The absorbance of each sample was determined with a UV spectrophotometer.

2.6 Statistical Analysis

The data generated were subjected to T-test statistics while significance differences were tested at 5 % level of probability.

3. RESULTS AND DISCUSSION

3.1 Physico-chemical Properties of oil from Selected Peanut Varieties

The result of the physico-chemical properties of oil from selected peanut varieties is shown in Table 1. refractive index, iodine value (gl/100g), specific gravity (g/cm^3), flash point (^{o}C), fire point (^{o}C), smoke point (^{o}C), cloud point (^{o}C), saponification value (mgKOH/g), % free fatty acid (%) and colour ranged between 1.11 and 1.52, 101.90 and 99.30, 0.94 and 0.92, 240.50 and 237.50, 316 and 301.50, 202.00 and 208.5, -2 and -4, 192.00 and 188.00, 31.21 and 30.71 and light brown to amber milky colour respectively.

The ratio of light's speed under vacuum to its speed on the second medium, which in this case, oil is referred to as refractive index of the oil. According to [18], refractive index is used in quality control to ascertain purity of materials. Values of 1.11 and 1.52 obtained for refractive index of the peanut oils were within the acceptable range of 1.4677 to 1.4707 for virgin, refined and refined-pomace oils reported for oils from vegetable/plant sources by [19].

The iodine values were 99.30 gl/100g in sample B and 101.90 gl/100g in sample A. according to [20], Iodine value measures the degree of unsaturation and it is an identity characteristic of oils, making it an excellent raw material for soaps cosmetics industries. Similarly, [12] reported that the lower the iodine value the lesser the number of unsaturated bonds; thus, the lower the susceptibility of such oil to oxidative rancidity. According to [21] peanut oils with such characteristic can find application in the manufacture of vegetable oil-based ice cream.

The result of the specific gravity showed that sample A had 0.94 while sample B had 0.92 specific gravity. The is a proof to the fact the peanut oil is less dense compared to water [22]. Flash point is usually the smallest temperature at which an oil will form a vapour and will immediately ignite on exposure to open flame. As such, higher flash point will make the oil more difficult to burn. The study showed that, the flash point of Samuel 25 (sample A) is 240.50^{o}C while the flash point of Samuel 24 (sample B) was 237.50^{o}C. The result of the flash point obtained in this study is similar to that reported by [23]. Lower flash points are indicators of good flammability and volatility. The high flash points of the peanut oils therefore signified that peanut oils are not flammable and volatile.

The fire point, also referred to as combustion point is the is the lowest temperature at which vapour of an oil continues burning for few seconds after an open flame ignition. Result presented in Table 1 showed that sample A had fire point of 316.00^{o}C while sample B had fire point of 301.00 ^{o}C. Hence, the peanut oils considered for this study are not a better choice as lubricating oil. Smoke point depicts a resistance of an oil to a heat source. It is also regarded as a lowest temperature through which an oil continues producing a clear and visible blue smoke. The result of the smoke point of two varieties of peanut is presented in Table 1. The smoked point of the two samples ranged from 202.00^{o}C to 208.5^{o}C for sample A and sample B respectively. [24] released that, oils with higher smoke point are better suited for deep frying, while those with smoke point below 200°C are not. As such, it can be confidently state that the oil from the selected two varieties of peanut in this study can be used in achieving deep frying of various food items.

Cloud point is the temperature at which wax begins to separate when oil tends towards low temperature. It is used as indicator of practical performance in automotive applications. The result of the cloud point of the peanut oils as shown in Table 1, revealed that sample A had cloud point of -2^{o}C while sample B had a cloud point of -4^{o}C. This is similar to that reported by [12] for oils extracted from some plant foods.

Saponification involves the process of splitting esters into carboxylate salts and alcohols through alkali actions. The result of the saponification value for sample B was 188.00 mgKOH/g and 192.20 mgKOH/g for sample A. Saponification value is a measure of oxidation during storage, and also indicates deterioration of the oils. [24] revealed that higher values of saponification value of an oil increase the volatility of the oils. Therefore, the high saponification values obtained in the present study is an indication that the oils may be suitable in soap making and shampoos. Similarly, [25] reported that oils with high saponification values as obtained in this study contain high proportion of lower fatty acids and as such, can be regarded as edible oils.

The result of free fatty acid ranges from 30.71 to 31.21 in sample B and sample A peanut oils respectively. Free fatty acids are results of oil and fat hydrolysis. [26] reported that "high concentrations of free fatty acids are undesirable in crude vegetable oils because they result in large losses of the neutral oil during refining". Higher values of free fatty acids are however undesirable because they can ultimately reduce the quality of oils. The most acceptable oil for consumption is that with low free fatty acid for avoidance of heart-related health conditions.

Table 1 indicated that the colors of the peanut oils were light brown and amber milky for sample A and sample B respectively. This result is similar to that reported by [27] for vegetable oils. According to [12], "color is one of the most key physical appearances of food materials since it influences consumer preferences and responsible for a final decision for purchasing by the consumer".

Table 1: Physicochemical Properties of Oil from Selected Peanut Varieties

SAMPLE	A	B	P-value
Refractive index	1.11±0.00	1.52±0.01	0.324
Iodine value (gl/100g)	101.90±1.10	99.30±0.57	0.095
Specific gravity (g/cm^3)	0.94±0.01	0.92±0.01	0.07
Flash point (^{0} C)	240.50±2.12	237.50±0.71	0.198
Fire point (^{0} C)	316.00±7.07	301.50±0.71	0.102
Smoke point (^{0} C)	202.00±1.41	208.5±0.71	0.028
Cloud point (^{0} C)	-2	-4	
Saponification value (mgKOH/g)	192.20±1.34	188.00±1.25	0.085
% Free fatty acid (%)	31.21±0.15	30.71±1.02	0.559
Colour	Light brown	Amber milky	

*Values are means ± standard deviations of triplicate determinations. Means in same column with *p*-value less than 0.05 are significantly different

Key: A = Samuel 25, B = Samuel 24

3.2 Proximate Composition of Flour from Selected Peanut Varieties

The proximate composition of flours from two selected varieties of peanut is presented in Table 2. The ash contents were between 2.28 % and 2.09%, moisture content (12.19% and 12.14%), fat (5.00% and 5.29%), fiber (2.00% and 2.05%), protein (20.92% and 20.95%) and carbohydrate content (57. 60% and 57.48%) for sample A and B respectively.
Ash content was highest for sample A (2.28%) while sample B recorded the least (2.09%). The results differed significantly (*P*=.05). [28] stated that "ash content of food material could be used as an index of mineral constituents of the food because ash is the inorganic residue remaining after water and organic matter have been removed by heating in the presence of an oxidizing agent. Hence, the sample with high percentage ash content as noticed in this present study is expected to have high concentrations of various mineral elements.

The moisture contents of the peanut flours are revealed in Table 2. Sample A contained higher moisture (12.19%) than sample B (12.14%). The results of the moisture contents were significantly different (*P*=.05) from one another. Higher moisture content observed for the two samples maybe due to greater water holding capacity of peanut flour. This is similar to the findings reported by [29], where similar values of moisture contents were also reported for groundnut flours.

The fat content of the peanut flours showed significant differences (*P*=.05). Sample B had fat content of 5.29 % while sample A had 5.00 % fat content. The results of these values are lower than the values of 10.37 to 18.01 % reported by [30] for maize flours fortified with pigeon pea concentrate but higher than the values of 0.59 and 1.58 % reported by [31] for flours from maize and soybean. The high fat contents of sample B as compared to the other sample maybe due to varietal differences as the two samples were subjected to same processes and processing conditions [32]. Also, this study reported lower values for fat because the peanut was defatted in the process of extracting its oil for the peanut oil used for this same study.

The fibre content of sample A was 2.00% while that of sample B was 2.05%. The result indicated a significantly (*P*=.05) richer fibre content for sample B than sample A. The high values of crude fibre observed in this study indicates that the peanut flours would help relieve constipation. The result of crude fibre in this study is however lower than 2.83 and 2.43 reported by [33].

The results of the protein content of the peanut flours showed no significant differences (*P*=.05). Sample A had protein content of 20.92% while sample B had protein content of 20.95 % respectively.

The results of these values are comparable with the values of the protein content of 24.70, 21.80 and 18.40 reported by [33]. Higher protein values as observed in this study indicates that consumption of this flour samples from peanut would help build lean muscle, reduce muscle loss and can also help produce new tissues. The results of the carbohydrate content of the peanut flours showed no significant differences (*P*=.05). Sample A had carbohydrate value of 57.60% while sample B had carbohydrate content of 57.48 % respectively. The carbohydrate contents reported for both sample A and sample B in this study are higher compared to 17.4-36.11 % reported for groundnuts by [33]. Higher amount of carbohydrates observed in this study implies that the peanut flours would act as good energy source alongside their rich protein contents.

Table 2: Proximate Composition (%) of Flour from Selected Peanut Varieties

SAMPLE	A	B	P-value
Ash	2.28±0.02	2.09±0.01	< 0.001
Moisture	12.19±0.01	12.14±0.01	0.004
Fat	5.00±0.02	5.29±0.01	< 0.001
Fibre	2.00±0.01	2.05±0.02	0.011
Protein	20.92±0.02	20.95±0.02	0.121
Carbohydrate	57.60±0.06	57.48±0.07	0.087

*Values are means ± standard deviations of triplicate determinations. Means in same column with p-value less than 0.05 are significantly different

Key: A = Samuel 25**,** B = Samuel 24

3.3 Mineral Composition of Flours from Selected Peanuts Varieties

The result of the mineral properties of flours from selected varieties of peanut is presented in Table 3. The calcium, iron, potassium (K) and sodium (Na) were 26.49 and 26.31 mg/100g, 5.62 and 5.60, mg/100g, 13.99 and 13.84 mg/g and 10.37 and 9.92 mg/100g. There were significant differences (*P*=.05) across the mineral elements except for the iron content which exhibited no significant difference (*P*≠.05).

The result of the mineral analysis of flours from selected peanuts shows that Samuel 25 (sample A) is a better source of calcium, iron, potassium and sodium than sample B which was also indicated in the higher values of ash (2.28%) reported for sample A in this study. The result of these findings is consistent with findings by [33] where similar mineral contents were reported for raw groundnut flour. The results indicate that the flours are essential for bone formation and would help the body develop and function normally. Iron plays a role in electron transferring reactions of the mitochondria. It is an important component of haemoglobin which is an oxygen–carrying pigment in the blood [34]. The presence of potassium indicates that the consumption of these peanut flours would help the body maintain normal levels of fluid contain in the cells while sodium plays similar role but in an inverse form. It is worth stating also that high values of potassium observed in the peanut flours would be relevant in treating and preventing low potassium levels, treatment of high blood pressure and prevention of stroke.

Table 3: Minerals Composition (mg/100g) of Flour from Selected Peanuts Varieties

SAMPLE	A	B	P-value
Ca	26.49±0.02	26.31±0.02	< 0.001
Fe	5.62±0.02	5.60±0.01	0.091
K	13.99±0.01	13.84±0.04	0.004
Na	10.37±0.02	9.92±0.02	< 0.001

*Values are means ± standard deviations of triplicate determinations. Means in same column with p-value less than 0.05 are significantly different

Key: A = Samuel 25, B = Samuel 24

4. CONCLUSION

This study established that the two selected varieties (Samuel 25 and Samuel 24) generally recorded good physicochemical, proximate, functional and mineral compositions. The result of the physicochemical parameters of peanut oil showed that refractive index, iodine value (gl/100g), specific gravity (g/cm^3), flash point (^{o}C), fire point (^{o}C), smoke point (^{o}C), cloud point (^{o}C), saponification value (mgKOH/g), % free fatty acid (%) and colour ranged between 1.11 and 1.52, 101.90 and 99.30, 0.94 and 0.92, 240.50 and 237.50, 316 and 301.50, 202.00 and 208.5, -2 and -4, 192.00 and 188.00, 31.21 and 30.71 and light brown to amber milky colour respectively. The two samples are good sources of nutrients. However, Samuel 25 peanut oil variety displayed higher amounts of minerals such as calcium, iron, potassium (K) and sodium (Na). The current study indicated that Samuel 25 peanut variety (Sample A) has good chemical and physical properties which are acceptable for the consumer. Therefore, the utilization of Samuel 25 variety in diet will give best results in combating diseases like cancer, diabetes and cardiovascular diseases based on the results indicated. In addition, knowledge of the refractive index, iodine value, specific volume, flash point, fire point, smoke point, cloud point, saponification value, % free fatty acids and colour of the peanut variety will help to optimize the processing parameters during processing and handling of peanut seed and peanut oil without affecting the desired quality.

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