PROXIMATE COMPOSITION OF THREE VARITIES OF GROUNDNUT AND PHYSICOCHEMICAL PROPERTIES OF EXTRACTED OIL AT DIFFERENT TEMPERATURE

BY

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Abstract

Groundnut is a legume which is widely grown and consumed as a food crop. Groundnut oil is derived from groundnut seed which is an edible oil that is consumed in every household in Nigeria. The groundnut from three (3) varieties was analysed for proximate composition and the extracted oil were analysed for their physico-chemical properties at heated temperature of 70°**C** and 80°**C** respectively. The range of the proximate composition for Moisture content, Ash, crude lipid, crude protein, crude fiber, Carbohydrate and calorific value for SAMNUT 24, SAMNUT 25 and SAMNUT 26 of the groundnut value obtained at 70°**C** were 3.31-3.85%, 5.81-6.22%, 34.68-47.91%, 28.88-29.02, 1.02-1.14%, 12.63-26.25% and 2228-2502KJ/100g respectively and at temp 80^0C 3.32%,-3.70%, 5.84%,-6.28%, 37.43%,-45.14%, 28.79%,-28.99%,0.85%,-1.13%, 15.16%,-23.58% and 2286 KJ/100g -2436 KJ/100g respectively. The physicochemical properties of the extracted oil include Peroxide, Saponification, Acid and free fatty acid value obtained at 70^0C were 2.80 mEq/kg-3.6/mEq/kg, 93.1 mgKOH/g -126.4mgKOH/g, 1.1 mgKOH/g -1.7 mg/KOH/g and 5.8 oleicacid/100g-8.5%oleicacid/100g) respectively. The value obtained at 80^oCwere, (2.6.mEq/kg3.0mEq/kg), (134.7mgKOH/g165.3.mgKOH/g), and (1.3mg/KOH/g1.7mg/KOH/g). (6.9% oleic acid/100g -8.7 % oleic acid/100g) respectively. This study has shown that edible quality cooking groundnut oil can be produced from SAMNUT 24 and SAMNUT 25 at a temperature of 70°**C**. SAMNUT 26 also have higher tendency of utilizelisation in the manufacturing of soap and paint at the temperature of 80℃. SAMNUT 26 have higher yield of lipid which implies high oil production.

Keywords: Groundnut oil, chemical extraction, Proximate, physicochemical, SAMNUT 24, SAMNUT 25 and SAMNUT 26

Introduction

Oil-bearing agricultural products are numerous and are of great economic importance to mankind. The oil contents in these products can be categorized as the edible and non-edible oils. Most oils are embedded in their parent materials and there is a need to extract them out before usage. Oil extraction is the process of recovering oil from oil-bearing agricultural products through manual, mechanical and chemical extraction. According to Sorin-Stefan *et al. (*2007) oil products industry produces edible and non-edible oils with about two-thirds of total oil products being the edible oils used directly in foods or in the manufacture of margarine, mayonnaise, bakery and pastry products, and as cooking fats. The remaining one-third of the total volume of produced oil is the technical oils, used in the production of various non-edible products, such as detergents, paint, glycerin, fatty acids, varnish, pharmaceuticals or cosmetics. Some common oil-seed crops include cotton, castor, groundnut and sunflower specifying the best factors combination for optimum oil extraction.

Oils and fat are esters of the three carbon trihydric alcohols, glycerin, and many straight chained monocarboxylic acids known as fatty acids (Weiss, 1980). The oils are classified according to their origin as vegetable or marine. Vegetable oils are more extensively studied due to their commercial characteristics. Vegetable oils are used in the

industry of processed food, including deep-fat frying (French fries, potato chips, seafood, fried chicken, donuts, snacks, etc.). Deep frying temperatures induce oil degradation, producing changes in its physical-chemical properties (Weiss 1980; Hamilton 1995). Such properties are being currently used to identify and control the quality of oils and fats in the food industry Potter and Hotchkiss (1995).

Groundnut (Arachis hypogaea L), is an important oilseed crop in Nigeria known by many other names such as peanut, earthnut, or monkey nut, Ahmed *et al.* (2019) despite its name and appearance, groundnut is not a nut, but rather specie in the legume or "Bean" family. It a leguminous oilseed crop cultivated around the semi-arid and subtropical region around the world Ajeigbe *et al., (*2015**).** The major groundnut producing states in Nigeria are Kano, Katsina, Kaduna, Jigawa, Sokoto, Zamfara and Kebbi in the Northwest; Adamawa, Bauchi, Yobe and Borno in the North East Ibrahim *et al*, **(**2021). One of the recent groundnut varieties registered and released in Nigeria are SAMNUT 24, SAMUT 25 and SAMNUT 26 Michael *et al.* (2019). Most extraction of groundnut oil was done locally for the production of groundnut cake *kukikuli* especially in Nigeria, therefore the amount of oil is less than expected, and also less work has been done on the quality of these new released varieties in production of oil. The physico-chemical properties of oil are amongst the most important properties that determine the quality and help to describe their present condition Angaye *et al.,* (2013).

This study research aimed at extracting oil from three new release varieties of groundnut using chemical extraction, treat the oil. Determine the proximate composition of the groundnut and physicochemical properties of the extracted oil at different temperature for their suitable for utilization domestically and commercially.

Materials and Methods

Sample Collection and Preparation

The three (3) varieties of groundnut Samnut 24, 25 and 26 were sourced from the Institute of Agriculture Research (11.165947 GPS) farm Samaru Ahmadu Bello University, Zaria. Kaduna State .Nigeria. All chemicals, solvents used in this study were of analytical grade and were sourced from Central Research Laboratory Tanke (8.4788 GPS) Ilorin kwara State Nigeria. The seed was condition to 3.5% moisture using cabinet dryer for all the samples and roasted at a temperature of 70℃ and 80℃ for 20 minute. Oil was extracted from the three varieties of groundnut seed using chemical extraction method as described by Aluyor *et al., (*2009*).* The various groundnut was analysed for it proximate composition (AOAC 2005) and the extracted oil for it physicochemical properties.

Determination of physico-chemical properties of groundnut oil

Determination of Peroxide Value

One gram each of the groundnut oil sample was dissolve in 30ml of mixture of acetic acid and (3:2v/v) shaken carefully, 0.5ml of Kl was then added. The mixture was shake for 1 minute for the reaction to liberate the iodide with peroxide. The solution was then titrated with standardized thiosulphate solution until yellow colour was almost discharged. 1m of w/w starch was then added and titration was continued until blue colour was discharge. The titration was repeated to obtain two concordance and blank titration was performed. (AOAC, 2005)

$$\text{Peroxide value} = \frac{1000X(VT-\text{VB})xM}{W}$$

Where, V_T=volume of the test sample V_B= volume of the blank C= Molarity of thiosuphate
W= Weight of sample

Determination of Iodine Value

About 0.1 gram of the groundnut oil sample was weighted into a conical flask and 20cm^3 of Dam reagent was added and the flask was paled in the dark for 2 hours 30 minutes at end of this period, 20cm^3 of 10% aqueous potassium iodide and 125cm^3 of distilled water was added using a measurable cylinder. It was titrated with 0.1N of $Na_2S_2O_3$ solution until colour charge to permanent pale yellow.

$$\text{Iodine value} = \frac{(b-a)x1.269x100}{w}$$

Where b = blank titer value, a sample titer value, N = Normality of thiosulphate, W=weight of sample.

Determination of saponification value:

The Saponification value was determined according to the titer metric method of (AOAC 2005) 2g of each oil sample was weighed into a conical flask and 25ml of alcoholic Potassium hydroxide was added. Solution was heated in boiling water for 1h. 1ml of 1% Phenolphthalein indicator was added and titrated with 0.5N HCl. A blank was prepared alongside the oil samples. The value was calculated by the formula:

N = Normality of HCl acid used,
A = Volume of H_2SO_4, for blank, ml,
B = Volume of H_2SO_4, for sample, ml, 56.1= Equivalent weight of potassium hydroxide,
W = Weight of oil used (2g)

$$\text{Saponification value:} = \frac{(B-A)\,N}{W}$$

Determination of Acid value

One gram (1g) of groundnut oil of each sample was weigh into a clean dry conical flask, 2.5ml of ethyl alcohol mixture was added to the oil sample and 0.5ml of phenolphthalein indicator, the mixture was gently swirled to dissolve. A clean dry burette was filled with 0.1 M KOH solution (already standardized against KHP solution) the level of solution was adjusted in the burette to remove air trapped at the stout of the burette, the content of the conical flask was titrated carefully against 0.1M KOH in the burette until a faint pink colour for the groundnut oil sample which persist for about 30 seconds.

$$\text{Acid value} = \frac{56.11\ X\ V\text{KOH}X\text{MKOH}}{W}$$

Where V=Volume in ml standard potassium or sodium hydroxide solution used
N= Normality of the potassium hydroxide solution or sodium hydroxide solution
V= Weight in g of the sample

Determination of free fatty acid

Two grams (2g) of groundnut oil was weigh into a conical flask and 20ml of premixed chloroform /methanol was mixed in ratio 1:1 and shake very well then 2 drop of phenolphthalein indicator was added, the mixture was titrated with 0.1M of sodium hydroxide in a burette until a light pink end point persist for 1 minute. Free fatty acid value was calculated as
Free fatty acid = Titer value x M x 28.2/weight of sample
Where 28.2 is a constant
M = molarity of the base.

Results and Discusssion

The result of proximate composition (%) and calorific KJ/100g of the three (3) Groundnut Cultivars varieties SAMNUT 24, SAMNUT 25 and SAMNUT 26 is shown in Table 1 and the physicochemical properties of the extracted oil is shown in Table 2.2

Table 1 Proximate Composition Groundnut of at 70°C and 80°C

Parameters 70°**C**	Samples		
	SAMNUT 24	SAMNUT 25	SAMNUT 26
Moisture	3.31±0.05	3.45±0.15	3.83±0.01
Ash	5.80 ±0.27	5.97±0.27	6.22.±0.02
Crude lipid	34.68±0.71	47.91±2.32	44.61±1.2
Crude protein	28.88.±0.02	29.02±0.04	29.01±0.00
Crude fiber	1.073±0.14	1.02±0.09	1.14±0.21
Carbohydrate	26.25.±1.87	12.63±2.68	15.18±1.04
Calorific KJ/100g	2228.±41.6	2502±43.30	2420±29.42
Parameters 80°**C**			
	Samples		
	SAMNUT 24	SAMNUT 25	SAMNUT 26
Moisture	3.32±0.01	3.73±0.02	3.71±0.08
Ash	5.84±0.11	6.28±0.10	6.04±0.01
Crude lipid	37.43±3.10	45.14±1.76	43.27±1.9
Crude protein	28.79.±0.02	28.83±0.00	28.99±0.06
Crude fiber	1.04±0.29	0.85±0.10	1.13±0.24
Carbohydrate	23.58.±3.29	15.16±1.80	16.32±1.51
Calorific KJ/100g	2286.±61.62	24.36±36.46	2396±45.80

Table 2 Physicochemical Properties of Chemical Extracted groundnut oil at 70°C

Parameters	Samples		
	SAMNUT 24	SAMNUT 25	SAMNUT 26
Peroxide (mEq/kg)	3.6.40±0.70	3.4.88±2.52	2.8.89±0.31
Saponification (Mg/KOH/g)	126.40±1.96	93.06±1.96	106.1±4.67
Acid (mgKOH/g)	11.64±0.19	12.90±0.40	17.11±0.40
Free Fatty Acid (% Oleic Acid/100g)	5.85±0.01	6.48±0.11	8.51±0.19

Chemical Extraction Method at 80°**C**

Peroxide (mEq/kg)	30.01±0.40	2.6.09±0.40	2.7.48±0.01
Saponification (Mg/KOH/g)	165.3±5.90	154.2±0.11	134.7±0.11
Acid (mg/KOH/g)	13.88±0.11	17.11±0.00	14.17±0.11
Free Fatty Acid (% Oleic Acid/100g)	6.98±0.01	8.74±0.11	7.12 ±0.10

Discussions

Moisture indicate the susceptibility of food to spoilage and microbial attack. The moisture content value at 70°**C** range from 3.31± 0.05%-3.84±0.00 % with SAMNUT 26 having the highest value and SAMNUT 24 having the least value. There was no significant difference in the value of SAMNUT 24 and SAMNUT 25 (3.33±0.15% and 3.46±0.15%) at P>0.05 except in SAMNUT 26. At 80°**C** the value range from 3.32±0.01%-3.74±0.04% with SAMNUT 25 having the highest and SAMNUT 24 the least value. There was no significant difference between SAMNUT 25 and 26 at 80°**C** and SAMNUT 24 and 25 at 70°**C** at p>0.05. The value reported in this study 3.31%-3.84% is lower compared to the value 8.60%-8.9% reported by Musa *et al*. (2010) and 4.9%-6.79% reported by Khalid *et al.,* (2017).

Ash content indicate the degree of mineral available in crop. The ash value of groundnut at 70°**C** obtained in this study range from 5.80± 0.2%7-6.23± 0.01% with SAMNUT 24 having least value and SAMNUT 26 with the highest value. At 80^0C the ash value range from 5.84± 0.07%-6.28± 0.12% with SAMNUT 25 having the highest value and SAMNUT 24 with the lowest value. There was no significant difference in all the varieties at both temperature at P>0.05. The ash content value obtained in this study (5.80-6.28%) is higher than the value 4.8% in SAMNUT 23 reported by Musa *et al*. (2010) and 1.20±0.00-1.86± 0.08 % reported by Khalid et *al*, (2017). The crude lipid value obtained in this study at a temp of 70°**C** range from 34.68±1.92%-47.91±2.32%. SAMNUT 25 have the highest lipid value compared to SAMNUT 24.There was no significant difference in SAMNUT 25 and 26 compared to SAMNUT 24 at P> 0.05. At 80°**C** temperature the crude lipid value ranges from 37.43± 3.1%-45.14± 1.78% with SAMNUT 25 having the highest value and SAMNUT 24 with the least value. There was no significant difference at P>0.05 between SAMNUT 25 and 26 compared to SAMNUT 24. Groundnut with high yield value can be extracted for commercial use for food and feed formulation that required high level of fat Khalid *et al* (2017).

Crude protein value at 70°**C** range between 28.88± 0.00% – 29.02± 0.04%. SAMNUT 25 have the highest value and 24 have the least value. At 80°**C** the value range within 28.79± 0.02%-28.99± 0.06% SAMNUT 26 have the highest value and SAMNUT 25 with the least value. There was no significant difference in all the varieties at both temperature. The crude protein value 28.88± 0.02%-29.01±% obtained in this study is higher than the value 20.71±0.61% -25.34± 0.23% reported by (Khalid *et al*.,2017; Musa *et al*., 2010) in SAMNUT 19 and SAMNUT 23 (19.70% and 24.90%). According to Joseph *at el*., (2023) groundnut is a good source of protein and can be of good health benefit to human. The crude fiber at the temperature of 70^0C fall within the range of 1.07± 0.09%-1.14± 0.21% with SAMNUT 26 showing the highest value and SAMNUT 25 with the least value. The crude fiber value at temperature of 80^0C range from 0.85± 0.09%-1.23± 0.24% with SAMNUT 26 showing the highest value and SAMNUT 25 with the least value. There was no significant difference at P>0.05 in all the three varieties at both temperature. Crude fiber is known to represent non digestible component of food Joseph *at el*., (2023).

The carbohydrate value range between 12.63±2.6% -26.25±1.87% with SAMNUT 24 having the highest value and SAMNUT 25 with the least value at a temperature of 70^0C. At the temperature of 80°**C** the carbohydrate value range from 15.16±1.80%-23.58±3.28%. SAMNUT 24 show the highest value and SAMNUT 25 have the least value. There was no significant difference at P>0.05 in SAMNUT 25 and 26 compared to SAMNUT 24 at both

temperature. Carbohydrate is a good source of energy giving food. The value reported in this study for all the sample except for SAMNUT 24 at 70^0C and SAMNUT 25 at 80^0C are higher than the value reported by Joseph *et al*., (2023).

The calorific value at 70°**C** ranges from 2228± 41.51KJ/100g - 2502± 43.30KJ/100g with SAMNUT 25 having the highest value and SAMNUT 24 showing the least value. The range of calorific value at 80^0C were 2286± 61.62KJ/100g-2436±36.46KJ/100g. SAMNUT 25 is having the highest calorific value while SAMNUT 24 show the least value. There was no significant difference between SAMNUT 25 and 26 compared to SAMNUT 24. At 70°**C**. There was significant difference in SAMNUT 25 compare to SAMNUT 24 and 26 at 80°**C**.

The Result of physicochemical properties of Groundnut oil from SAMNUT 24, 25 and 26 is shown in Table 2

Peroxide value is use to measure the extent of rancidity and also as an indicator of the quality of oil (Ahmed *et al.*, 2019). The peroxide value obtained in this study were (3.6.40±0.70 mEq/kg) 3.4.88±2.52 (mEq/kg) and 2.8.89±0.31 (mEq/kg) There was no significant difference at p>0.05 in peroxide value obtained in SAMNUT 24 and 25 (3.6 ±0.07mEq/kg-3.4±0.02mEq/kg) compared to SAMNUT 26 at 7O°C. The peroxide value obtained at 80^0C were (3.0.01±0.40mEq/kg), (2.6.09±0.40mEq/kg) and (2.7.48±0.01mEq/kg). There was no significant difference in peroxide among the three sample at 80°C.

There was decrease in peroxide value in SAMNUT 24, 25 and 26 (3.0 ± 0.01, 2.6±0.03 and 2.7±0.01) as the temperature increase to 80°C. The decrease in peroxide value with increase in temperature indicate low level of rancidity and deterioration .it also signify high quality and stability at 80°C. The PV value obtained in this study is lower than the value 4.3mEq/kg and 5.7mEq/kg reported by (Ahmed *et al*., 2019). It is also within the standard < 10 given by (NAFDAC, 2005).

Saponification value give information on the quality and mean weight of the acid in a given sample. (Ahmed *et al*., 2019). Saponification value of 126.4±1.1 mgKOH/g, 93.06±1.1mgKOH/g and 106.1 ± 4.7 mgKOH/g were obtained for SAM 24, 25 and 26 at 70^0C while 165.3±5.8 mgKOH/g. 154.2± 1.1mgKOH/g and 137.7±1.1 mgKOH/g were obtained at the temperature of 80^0C. SAMNUT 24 have the highest SV value compared to all the other samples.

There was no significant difference at p> 0.05 in SAMNUT 25 and 26 compared to SAMNUT 24 at 70^0C likewise SAMNUT 24 and 25 compare to SAMNUT 26 at 80^0C. According to Adesipe and **Makanjuola** (2019) oil with high saponification value contain high proportion of lower acid this properly make the oil useful in soap making Acid value are used to measure the extent to which glycerides in the oil has been decomposed by lipase and other physical factors such as light and heat (Pandyrangan *et al*., 2014). The acid value obtained in this study were 1.1.64±0.19mgKOH/g, 1.2.90±.0.31mhKOH/g and 1.7± 0.40mgKOH/g in SAMNUT 24, 25 and 26 with SAMNUT 24 having the least value and SAMNUT 26 having the highest value at a temperature of 70^0C respectively.

An Increase in the temperature to 80°**C** gives AV value of 1.3±0.11mgKOH/g, 1.7±0.00mgKOH/g and 1.40± 0.11mgKOH/g in SAMNUT 24, 25 and 26 respectively. SAMNUT 25 have the highest acid value at this temperature. The acid value is also used as an indicator of the edibility of an oil and suitability for use in the paint and soap industries. Low level of acid value of oil sample shows that the oil is comparable to edible oil, Adesipe and Makanjuola (2019). The acid value obtained in this study is within the value reported by (Moshood et *al*., 2022).

Free fatty acid signify the extent of hydrolytic rancidity in oil. The Free fatty acid value obtained in this study for SAM NUT 24, 25 and 26 were 5.85±0.01% oleic acid/100g, 6.48±0.11% oleic/100mg and 8.59±1.19% acid value at 70°**C** and 6.97±0.11% oleic acid /100g, 8.7 ±0.19% oleic acid /100g and 7.12 ± 0.01% oleic acid /100g at 80°**C** Sam 25 at 70°**C** have the highest FFA. The value of FFA obtained in this study fall within the range reported by

(Orhevba *et al*., 2016) and also within the limit by the codex Alimentary Commission groundnut oil. Increase in temperature can lead to high degree of free fatty acid which make the oil to be highly susceptible to rancidity while low temperature at low free fatty acid value increase the quality and edibility of the oil. There was significant difference at P> 0.05 in SAMNUT 24 and SAMNUT 25 as the temperature increase from 70C℃ to 80℃ compared to SAMNUT 26. In SAMNUT 26 there was decrease in the free fatty acid as the temperature increases to 80℃. Increase temperature from 70℃ to 80℃ has effect on the free fatty acid value of SAMNUT 24 and SAMNUT 25

Conclusion

The proximate composition were not affected by increase in temperature. All the samples are good source of carbohydrate, crude protein, lipid and ash and can be used in the fortification of food that are low in these nutrient. Similarly, SAMNUT 25 and 26 are high in crude lipid and can give higher yields of oil among the samples. The oil extracted from the 3 varieties can be good sources of cooking and also high value of saponification in SAMNUT 25 can be used in the manufacturing of soap and paint. The study also shows that proximate and physicochemical properties were not affected by the extraction method (chemical extraction).

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