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Evaluation of physiochemical, bacteriological and selected heavy metals of branded and unbranded groundnut oil samples collected from Galadima market of Fagge Local Government Area Kano State, Nigeria

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ABSTRACT

Aim: This study was aimed to evaluate physiochemical, bacteriological and selected heavy metals of branded and unbranded groundnut oil samples collected from Galadima market of Fagge Local Government Area Kano State Nigeria.

Method and Materials: A total of five (5) samples of groundnut oil were collected and analysed for physiochemical properties such as (moisture content, iodine value, saponification value, specific gravity, density, acid value and ester value) microbiological properties such as (yeast, mould, *E coli* and *salmonella)* and some heavy metals using standard method.

Results: On the physiochemical properties, the moisture content of the oil samples analysed ranged from 5.39±0.57-15.47±0.32 %. The specific gravity of the oil samples ranged from 1.48±0.02-1.50±0.01 and the specific density ranged from 0.95±0.01-0.96±0.01. The iodne value of the samples analysed ranged from 155.13±0.31-203.52±1.21 g/100g. The saponification value of the oil samples ranged from 84.1±0.51-123±0.86 mgKoH/g. The acid values of the oil samples ranged from 1.51±0.16-1.98±0.01 mgKmH/g. The ester value of the oil samples ranged from 82.34±0.49-121.15±0.81 mgKoH/g. On the microbiological properties, the results E coli ranged from 3-21 the analysis on yeast ranged from 4-6 for the unbranded oil samples while none was detected on the branded oil samples.

Conclusion: It was concluded that most of groundnut oils have high shelve life and can be stored for a long time. In addition to good nutritional value, with all falling within the standard limit set by NAFDAC. Furthermore, it indicated that groundnut oil in general have more nutritional value and pose no significant health risk to the consumers in Kano state.

Keywords: Groundnut oil**,** physiochemical properties, microbiological properties, heavy metals unbranded and branded oil.

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Introduction

Groundnut *(Arachis hypogaea* L.) originated from South America (Wiess, 2000). It is one of the most popular and universal crops cultivated in more than 100 countries in six continents; Asia, Africa, Oceania, North and South America and Europe ((Asemave, *et al.,* 2012).Major groundnut producing countries are China (40 percent), India (23 percent) and Nigeria (8.4 percent) (World Bank, 2003).

Developing countries account for over 95 percent of total world groundnut area and about 94 percent of total world production. Production is concentrated in Asia and Africa, with Africa accounting for 35 percent of global area and 21 percent of total output mainly in Nigeria, Senegal and Sudan. In Nigeria, groundnut is cultivated mainly in the northern parts especially Kano, North Central, North West and North Eastern states. World production of groundnut was 35.9 million tonnes. Asia remained the largest producer with 20.5 million tonnes, India 10.9 million tonnes, and Africa, 4.5 million tonnes. According to RMRDC (2005) report, the total output of groundnut for Nigeria as at 2002 was 1,976,490.80 tonnes with a range of 47.00 – 73,000 tonness for the States. Bauchi State had the largest output (73,000 tonnes) followed by Nasarawa

(70,420 tonnes) and Edo State had the least with 47.00 tonnes. The mean groundnut output from farmer's field for all the States was 15.72 tonnes. Sokoto State had the highest mean output of 57.00 tonnes, followed by Benue with 52.0 tonnes, Jigawa 27.33 tonnes, Kano, 26.29 tonnes, Yobe, 25.70 tonnes, Zamfara, 25.55 tonnes and Kaduna, 22.67 tonnes. Abuja had the least with 2.25 tonnes. Annual average production figure for Nigeria was 456 metric tonnes of groundnut oil, 713 metric tonnes of groundnut cake and 2,652 metric tonnes of unshelled groundnut (FAO, 2002).

Groundnut oil production is actually a post-harvest operation which is referred to as processing. Processing may be regarded as a way of converting harvested agricultural produce into other forms of products that can be preserved over a long period of time. In this case it is converting groundnut seeds into groundnut oil and groundnut cake commonly called "kuli-kuli" in the North. Processing of agricultural products serves as a source of additional income to the processor as well as boost household food security especially among the rural poor. In the process of transforming this product from subsistence to commercial, socio-economic changes of the processor is vital as he occupies key position in production, processing and marketing of agricultural product (NAERLS, 2000).

The extraction of oil from groundnut constitutes an important agricultural processing activity for women in Nigeria especially in the northern States. The process involves a number of steps that include cleaning, roasting, de-skinning, kneading and frying and the extraction of oil. The oil extraction process is mainly traditional, characterized by drudgery and time consuming.

In Nigeria, groundnut oil accounts for as much as 17 percent of the total agricultural export earnings because it does not meet domestic demand. The shortfall in domestic demand is 300,000 to 400,000 metric tons (Ojowo, 2004). Its husk (shell) is used as fuel, roughage, and litter for livestock, mulch, and manure and as soil conditioner. Groundnut seed contains 40-50 percent protein and 10-20 percent carbohydrate. Groundnut seeds are nutritional sources of vitamin E, niacin, flavin, calcium, phosphorous, magnesium, zinc, iron, riboflavin, thiamine and potassium. It is also used as animal feed, raw material for oil, cake and fertilizers. The multiple uses of groundnut plant make it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries (Stigter, 2006). Refined groundnut oil could be used in a variety of manufactured food products such as biscuits, cakes, crisps and ready meals. The unique property of stability and long shelf life can make it a preferred choice for frying. As stable oil, it is often used as a base for some pharmaceutical products and minor food ingredients such as colours and flavours. Groundnut oil is also used in the preparation of skin cream, for instance, eczema cream though they could be problematic to those with a history of allergy due to the presence of groundnut protein. Groundnut oil is used extensively for massaging polio patients. It is also used as a carrier in the treatment of asthma and other ailments (Stigter, 2006).

There are two major types of groundnut oil which are branded and non-branded groundnut oil. Branded groundnut oil: this is the oil that has been refined in the factory examples of branded oils include; kings cooking oil, power oil, Mamador oil, Laziz oil, Nithanli oil etc. Non-branded oil: this is the locally made groundnut oil that has not been refined or is yet to be refined and has no trade name (Babatunde and Bello, 2016). Therefore, objective of the study was to evaluate physiochemical, bacteriological and selected heavy metals of branded and unbranded groundnut oil samples collected from Galadima market of Fagge Local Government Area Kano State Nigeria.

Materials and Methods

The following materials were used; Autoclave, Distiller, Incubator, Oven, Colony counter, pH meter, Atomic Absorption Spectrophotometer.

Sample collection

A total of five (5) samples were collected in a plastic container of one (1) litre from different locations within the *Galadima* Market, *Fagge* LGA, Kano State, Nigeria as described by Musa *et al*., 2012 and Negash *et al.,* 2019.

Determination of iodine value

A known weight of oil/fat with a known volume of standard solution of iodine monochloride (ICl). Excess ICl will be reacted with KI and the iodine liberated will be titrated against $Na_2S_2O_3.5H_2O$ with starch as indicator. A 0.30g of groundnut oil was weighed accurately. About 10.00 ml of CCl_4 and 25.00 ml of Wits solution were added successively and the flask will be vortexed and allowed to stand in a dark cupboard for one hour. A 15.00 ml of

10.00 % potassium iodide and 100.00 ml of distilled water were added followed by 1.00 ml of starch solution. It will be titrated against 0.10 N $Na_2S_2O_3$ until the blue color disappeared indicating an end point. Blank solution will be titrated without the oil sample. The value was calculated using equation (1) (Musa *et al* 2012 and Negash *et al.,* 2019).

$$\text{Iodine value} = \frac{(b - a) \times N \times 1.269 \times 100}{W} \quad \ldots\ldots (1)$$

Where: b = blank titre value, a = sample titre value, N = normality of thiosulphate andW = weight of sample.

Determination of saponification value

The oil was treated with excess alcoholic KOH, it was saponified and the excess KOH will be titrated against 0.50 NHCl. 0.50g of the oil was weighed in a quick-fit-reflux flask and 25.00 ml alcoholic KOH was added. It was refluxed for 30.00 minutes, so that it gets simmer. The flask was cooled and 1.00 ml of phenolphthalein indicator was added and titrated against 0.50 NHCl. The value was calculated using equation (2) (Musa *et al.,* 2012 and Negash*et al.,* 2019).

$$\text{Saponification value} = \frac{56.1 \times (b - a) \times N}{W} \quad \ldots\ldots (2)$$

Where: W= weigh of sample = 0.50g, b = blank titre value, a= sample titre value and N = Normality of HCl.

Determination ofacid value

It is the percent of free fatty acid expressed as oleic acid. Acid value of oil was determined by titration of a known weight of the oil against 0.25NNaOH using phenolphthalein as indicator

$$C_{17}H_{33}COOH + NaOH \longrightarrow C_{17}H_{33}COONa + H_2O \ldots (3)$$

Extracted groundnut oil (1.0 g) was weighed in a conical flask and 50.00 ml of denatured alcohol will be added, vortexed and two drops of phenolphthalein indicator was added and the solution titrated against 0.25NNaOH with vigorous shaking until permanent light pink colour was obtained. The value was calculated using equation (4)(Musa *et al.,* 2012 and Negash*et al.,* 2019).

$$\text{Percent acid value} = \frac{100 \times 2.82 \times V}{W \times 1000 \times 4} \quad \ldots\ldots (4)$$

Where W = weight of oil = 1.00 g, V = titre value of 25N NaOH and 2.82= equivalent weight of oleic acid.

Determination of ester value

About 5.00 ml of the extracted oil was weighed in a quick-fit refluxing flask. About 25.00 ml of alcoholic KOH with ten drops of phenolphthalein indicator were added. It will be then reflux for one hour. Cooled and titrated against 0.5NHCl. Blank titration was also carried out in the same manner without the oil. The value was calculated using equation (6) (Musa *et al.,* 2012 and Negash*et al.,* 2019).

$$\text{Ester value} = \frac{(\text{Blank sample} - \text{titre value}) \times 0.5 \times 56.1}{W} \quad \ldots (6)$$

Determination of specific gravity

A Pycnometer that is specific gravity bottle was used in measuring the density/specific gravity. The specific gravity of oil is the ratio of the weight in air of a given volume of the oil at a define temperature to that of the same volume of water at same temperature.

Cleaned, dried pycnometer was weighed. It was filled with water maintained at 20^0C and weighed again. The bottle was emptied, dried and filled with oil and weighed. The value was calculated using equation (7) (Musa *et al.,* 2012 and Negash*et al.,* 2019).

$$Specific\ gravity = \frac{\text{Weight of oil}}{Weigt\ of\ water\ at\ 20^{\circ}C} \ldots\ldots (7)$$

Microbiological analysis

The sample were analysed for the presence of yeast, mould and *Escherichia coli* (*E. coli.).* Additional examination for the presence of pathogenic organism like salmonella was carried out as described by Okwelle and Nwabueze, 2020.

Yeast and mould count

About 25.00 ml of the original oil sample was mixed with 225.00 ml of buffer peptone water and from this solution; 0.10 ml was transferred to Rose Bengal jar and inoculated using spreading plate method and incubated at 30^OC for about 5-7 days. Then the yeast and mould were enumerated and rated cfu/ml

Escherichia coli (E.coli) count

*The*E coli count was done by transferring a loop full from E.C broth to nutrient broth and then subjected to biochemical test (Okwelle and Nwabueze, 2020).

Salmonella species count

About 25.00 ml of the oil sample was mixed with 225.00 ml of buffer peptone water and non-selective enriched for 24hours. Afterwards it was transferred to selenite cystine broth for selective experiment and incubated for 18hours. Then a loop full of the sample was transferred to XLD agar and incubated at 37^OC for 24hours. Afterwards the suspected

colonies were subjected to biochemical test and the results were reported as present or absent as described by Okwelle and Nwabueze, 2020

Mineral analysis

The selected heavy metals in the samples were determined using Atomic Absorption Spectrophotometer (AAS), Buck 210VGP model (Akan *et al.,* 2009). About 50.00 g of each sample (groundnut oil) were influxed with 300.00 ml of extractant (18% HCl ×0.01% EDTA), 50.00 ml then was removed from the lower aqueous layer, and the action repeated with fresh extractant. The two extracts were combined and diluted with 10.00 ml of water, 5ml of concentrated HNO3, was added, and the mixture was boiled down to a volume of 2ml. this was then diluted to 25.00 ml and taken to the AAS for analysis and read from the working curve as described by Babatunde and Bello 2016.

Results and Discussion

The result revealed that the pH ranged from 6.16-6.77 (Table 1). It showed that the oil samples were weakly acidic and almost neutral for some of the oil samples. It implied that they contained low amount of fatty acid making it fit for human consumption as per Babatunde and Bello (2016), Chabiri *et al*., (2009) and Musa et al., (2012). The colour of the groundnut oil were either light amber, golden amber or dark amber. These were acceptable colours for vegetable oils as reported by Babatunde and Bello (2016), Chabiri *et al*., (2009) and Musa et al. (2012), Okwelle and Nwabueze (2020) and Siyanbola*et al.* (2013).

Table 1. Physical properties of oil samples collected from *Galadima* market of Faggea LGA of Kano State.

Sample	Colour	Odour	pH	Temperature (o_C)
A	Light amber	Nil	6.75	25.0
B	Light amber	Nil	6.77	25.0
C	Light amber	Nil	6.18	27.0
D	Golden amber	Nil	6.54	26.0
E	Dark amber	Nil	6.16	27.0

The moisture content of the oil samples analysed ranged from 5.39±0.57 to 15.47±0.32 %. All the oil samples analysed were very high moisture contents when compared with results obtained by Siyanbola *et al*., (2013), Selve and Arya (2018) and Onawo and Adamu (2018). However, these results were still within the standard set by NAFDAC.

The specific gravity of the oil samples ranged from 1.48±0.02 to 1.50±0.01 and the specific density ranged from 0.95±0.01 to 0.96±0.01. Which also shows that all the samples were slightly dense when compared with Musa et al. (2012), Okwelle and Nwabueze (2020), Onawo and Adamu (2018) and Siyanbola *et al*., (2013).

The iodne value of the samples analysed ranged from 155.13±0.31-203.52±1.21 g/100g. These values compared to results obtained by Musa *et al*., (2012) and much higher than those obtained by Siyanbola *et al*. (2013). This was due to the difference in the gram of groundnut oil sample used for the analysis. Iodine value was an indicator of double bindings in the molecular structure which influences the long-term stability properties of the groundnut oil (important for storage). The greater the iodine value, the more unsaturation and the higher the susceptibility of oxidationas reported by Musa *et al*. (2012), Okwelle and Nwabueze (2020), Selve and Arya (2018), Onawo and Adamu (2018), Gulluoglu *et al*., (2016) and Siyanbola *et al*., (2013).

The saponification value of the oil samples ranged from 84.1±0.51 to 123±0.86mgKOH/g. the values obtained were not in line with the standard guidelines set by NAFDACas well as Musa *et al*., (2012), Okwelle and Nwabueze (2020), Onawo and Adamu (2018) and Siyanbola *et al*., (2013). Studies showed that low saponification value indicated that the groundnut oil contains triglycerides and might not be useful in the production of soap. Saponification was only of interest if the oil is for industrial purpose, as it has no nutritional significance but due to the fact that each fat has within the limits of biological variation, a constant fatty acid composition determination of the saponification values was a reasonable means of characterizing the fat as reported by Tesfaye and Abebaw (2016), Okwelle and Nwabueze (2020), Gulluoglu (2016) and Onawo and Adamu (2018).

The acid values of the oil samples ranged from 1.51±0.16 to 1.98±0.01mgKOH/g. these values obtained are in agreement with other studies. Acid values of oil suitable for consumption purpose should not exceed 4mg/g. level of acidity was referring to suitable quality of oil. The ester value of the oil samples ranged from 82.34±0.49 to 121.15±0.81mgKOH/g. The values are not in agreement with what was reported by Siyanbola *et al*. (2013).

Table 2. Physiochemical analysis of oil samples collected from *Galadima* market of Kano State.

Sample	Moisture content (%)	Specific gravity at 27^oc	Specific density at 27^oc	Iodine value (g/100g)	Saponification value (mgKOH/g)	Acid value (mgKOH/g)	Ester value (mgKOH/g)
A	15.49±0.32	1.50±0.01	0.96±0.01	173.50±0.36	123±0.86	1.88±0.05	121.15±0.81
B	6.42±0.81	1.48±0.02	0.95±0.01	203.52±1.21	120±0.32	1.51±0.16	181.49±0.16
C	9.52±0.52	1.49±0.01	0.96±0.01	191.06±0.20	84.1±0.51	1.76±0.02	82.34±0.49
D	12.42±0.36	1.50±0.01	0.96±0.01	177.55±0.62	86.5±0.17	1.98±0.01	84.52±0.16
E	5.39±0.57	1.50±0.01	0.96±0.01	155.13±0.31	110±0.23	1.86±0.21	108.14±0.02

Table 4. Microbiological analysis of oil samples collected from Galadima market of Kano State.

Sample	Yeast	Mould	E. coli	Salmonella
A	No growth	No	<3	No growth
B	No growth	No	<3	No growth
C	5	3	9	No growth
D	4	3	11	No growth
E	6	2	21	No growth

The higher the ester values, the more intact the ester bond between the glycerol molecules and the fatty acids. Therefore, oil samples analysed are of high quality and can be stored for a longer period of time as reported by Musa *et al*., (2012), Okwelle and Nwabueze (2020), Onawo and Adamu (2018), Gulluoglu *et al*., (2016) and Siyanbola *et al*., (2013).

It showed that the microbiological analysis of the oil samples (Table 4). The analysis on E coli ranged from 3-21 the analysis on yeast ranged from 4-6 for the unbranded oil samples while none was detected on the branded oil samples. The analysis on mould ranged from 2-3 for the unbranded oil samples while none was detected on the branded oil samples. No salmonella *spp* was detected in al oil samples.

Groundnut oils make an important contribution to the diet of people seeking as a good source of lipid and fatty acid for human nutrition including the repair of worn out tissues, new cell formation as well as a useful source of energy.

Conclusion

It was concluded that most of groundnut oils have high shelve life and can be stored for a long time. In addition to good nutritional value, with all falling within the standard limit set by NAFDAC. Furthermore, the results indicated that groundnut oil in general have more nutritional value and pose no significant health risk to the consumers in Kano state.

Reference

Asemave K, Ubwa ST, Anhwange BA and Gbaamende AG (2012). Comparative evaluation of some metals in palm oil, groundnut oil and soybean oil from Nigeria. International Journal of Modern Chemistry, 1(1): 28-35.

Babatunde OA and Bello GS (2016). Comparative assessment of some physicochemical properties of groundnut and palm oils sold within Kaduna metropolis, Nigeria. IOSR Journal of Applied Chemistry, 9(11): 2278-5736.

Chabiri SA, Hati SS, Dimari GA and Ogugbuaja VO (2009). Comparative quality assessment of branded and unbranded edible vegetable oils in Nigeria. The Pacific Journal of Science and Technology, 10(2): 927-934.

FAO (2002). *Groundnut Enterprise in Kaduna State*. Retrieved on August 8, 2007 from http://rmrdc.gov.ng/surveyreport2005/Groundnut.pdf.

Gulluoglu L, Bakal H, Onat B, El Sabagh A and Arioglu H (2016).Characterization of peanut (*Arachis hypogaea L.)* seed oil and fatty acids composition under different growing season under Mediterranean environment. Journal of Experimental Biology and Agricultural Sciences, *4*(5S): 564-571.

Musa M, Sulaiman AU, Bello I, Itumoh JE, Bello K, Bello AM and Arzika AT (2012). Physicochemical properties of some commercial groundnut oil products sold in

Sokoto metropolis. Northwest Nigeria. Journal of Biological Science and Bioconservation, 4: 17-24.

NAERLS (2000). An assessment of contributions of women to family farming in North Eastern Nigeria.

Negash YA, Amare DE, Bitew BD and Dagne H (2019). Assessment of quality of edible vegetable oils accessed in Gondar City, Northwest Ethiopia. BMC Research Notes, 12, Article number 793.

Ojowo O (2004). Presidential Initiatives and Agricultural Competitiveness, Issues and Challenges. In NESG (Ed) Nigerian Agriculture: Transisting to Large Scale Commercial Farming Competitiveness. Lagos: A Report on the 3rd NESG-Agric Summit. Pg 49-53.

Okwelle AA and Nwabueze FC (2020). Microbiological Quality Assessment of Unbranded Groundnut Oil Sold in Major Markets in Port Harcourt City, Rivers State, Nigeria. International Journal of Current Microbiology and Applied Sciences, 9(5): 2964-2974.

Onawo AS and Adamu MO (2018). Microbiological Profile and Quality Assessment of Unbranded Groundnut Oil Marketed at a Major City in Nigeria, Sub-Sahara Africa. Invention Journal of Research Technology in Engineering and Management, 2(3): 36-43

Raw Materials Research and Development Council (RMRDC, 2004), Groundnut Enterprise in Kaduna: Retrieved on November 21, 2007 from http://rmrdc.gov.ng/surveyrport2005/Groundnut.pdf.

Siyanbola TO, James OO, Eromosele CO, Akinsiku AA, Nwinyi OC, Edobor Osoh A, Enebe AO, Anake WU and Falomo AA (2013). Physicochemical Analysis, Phytochemical Screening and Antimicrobial Activities of some Vegetable Oils from Ogun State, Nigeria. International Journal of Current Research, 5(4): 992-997.

Stigter K (2006). Agrometerological Services in Various Parts of the World, Under Conditions of Changing Climate. Austin Bourke Memorial Lecture Presneted in the Roy and Irish Academy, Dublin, 2 March. Retrieved on November 21, 2007

Tesfaye B and Abebaw A (2016). Physico-Chemical Characteristics and Level of SomeSelected Metal in Edible Oils. Hindawi Publishing Corporation Advances in Chemistry, Volume 2016 | Article ID 3480329.

Wiess DO (2000). Groundnut Policies, Global Trade Dynamics and the Impact of Trade Liberalization.

World Bank (2003). Groundnut Policies, Global Trade Dynamics and The impact of Trade Liberalization

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