# Comparative Studies on the Quality and Bacterial Contamination of Five Varieties of Groundnut (*Arachishypogaea L.)*

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D.O.I: 10.56201/ijaes.v9.no3.2023.pg31.38

***ABSTRACT***

*Studies on the quality and bacterial contamination of five varieties of groundnut were carried out in the Department of Plant Science and Biotechnology, Rivers State University. Nutrient analysis was conducted in accordance with the guideline of Association of Official Analytical Chemists (AOAC) while the laboratory cultural method was used for bacterial isolation and characterization. The proximate assessment revealed the presence of moisture, ash, lipid, fibre, carbohydrate and protein. However, highest lipid (49.25±0.05%) and fibre (4.95±0.50%) were recorded for SM 10 while LM had highest values of moisture (7.8±0.00%) and carbohydrate (31.25±0.37%). Highest ash (6.55±0.05%) and protein (36.74±0.04%) were seen for SN22 and SN23 respectively.The mineral evaluation revealed calcium, iron, magnesium, phosphorus, potassium and sodium to be present in all test groundnut samples. Although, SN24 recorded highest calcium (130.00±0.00mg/100g) potassium (950.00±0.00mg/100g) and iron (4.70±0.00mg/100g). However, highest values magnesium (161.00±1.mg/100g), phosphorus (376.50±0.50mg/100g) and sodium (107.30±87.70mg/100g) were recorded for SN22, SN10 and SN23 respectively. Bacteria investigation showed the occurrence of five organisms viz: Bacillus cereus, Micrococussp, Staphylococcus sp and Bacillus mycoide. However, SN10 and SN23 had highest number of bacterial flora (3 genera) while SN22 had least bacterial flora (1 genus). Generally, all groundnut varieties possessed vital nutrient but could still be contaminated by bacteria.*

***Keywords:*** *Groundnut, varieties and bacterial contamination*

## INTRODUCTION

Groundnut (*Arahishypogaea*L.) is a member of the fabaceae familyEke-Ejiofor*et al*., (2012),It is a legume botanically,although it is widely identified as a nut and has similar nutrient profile with tree nuts Ros, (2010). It is an edible annual crop that is grown in many regions of the world including tropical, sub-tropical and temperate regions. In Nigeria huge area of land are invested in cultivating groundnut. Akimibosun and Osawaru (2015), Odu and Okonkwo (2012), stated in

their findings that approximately 1.4 million hectares of land are used to grow groundnut, this is mostly in the northern region in Nigeria.

In most developing countries groundnut is an essential crop(Adebesin*et al.*, 2001; Odu and Okonkwo, 2012). Comparing groundnut to the likes of cashew nut, African breadfruit seed and conophor nut (African walnut or *Tetracarpidiumconophor*nut); it contain more plant protein than any other legumes or nuts(Settaluri*et al*., 2012; Sibte-Abbas *et al*., 2015). It is one of the major indigenous edible nuts consumed in southern Nigeria (Nwabunnia and Ezeimo, 2015).

Human and animals need groundnut in their diet as it is an essential oil crop. The oil obtained from groundnut is used in cooking and baking. Ochem*et al* (2014) also stated that groundnut can be processed by roasting it in oil and it can be consumed as snacks or as food supplement. As well, groundnut is used together with cereals such as maize, millets, sorghum for the manufacturing of weaning food(Ikeh*et al*., 2001). Literatures have shown groundnut kernels to have about 25% protein which is 1.3 times higher than meat, 2.5 times higher than eggs and 8 times higher than fruit (Aletor and Ojelabi, 2007).

In some regions in Nigeria the microbiological quality of groundnut consumed has been reported (Odu and Okonkwo 2012). Also microbial characterization ofdakuwa, a Nigerian cereal/ groundnut snac, have also been reported by Ochem*et al*. (2014).

## MATERIALS AND METHODS

### Collection of groundnut samples

Four kilograms of each of the 4 varieties of groundnut was collected from IAR&T ABU Zaira, Nigeria, while one kilogram of groundnut was purchased from, Mile 3 market in Port Harcourt, Rivers State. The groundnut varieties identified were Samnut 10, Samnut 22, Samnut 23, and Samnut 24 and a control form was obtained from the market.

### Bacteria Studies

### Media Preparation

Nutrient Agar medium was prepared by weighing 28g of nutrient agar into 1000ml Erlenmeyer flask. This was brought to boiling to dissolve completely by heating it over Bunsen burner flame for 30 minutes. The medium was sterilized at 121$^{o}$C for 15 minutes using the autoclave at 15psi. The medium was allowed to cool down to 45$^{o}$C and 15ml of the medium was poured into sterile Petri dishes. The plates were allowed to set and dried in an oven before used.

### Normal Saline Preparation

The normalsaline was prepared by weighing 8.5g of Sodium chloride and dissolved in 1000ml of distilled water. Nine (9) millilitre of the solution was dispensed into various test tubes and

cocked, and then sterilized by autoclaving at $121^0$C for 15 minutes at 15psi.

**Serial Dilution**

Tenfold serial dilution was carried out for the isolation of bacteria from the sample. 1gram of samples was weighed into 9ml of sterile normal saline. The samples were agitated and 1ml was transferred into 9ml sterile normal saline in test tube given $10^{-1}$ dilution. 1ml was transferred from initial test tube into 9ml sterile normal saline in series to the fifth test tube as $10^{-5}$ dilution.

**Characterization and Identification of Bacterial Isolates**

Identification of the isolates was based on their cultural morphology, microscopic examination and biochemical tests. References were made to Bergey's manual of determinative Bacteriology (1992) for identification of bacteria. Morphological studies were carried out on different media plates used for the isolation of the organisms; pure colonies were isolated based on colony size, shape, pigmentation, elevation and texture of the individual organisms after 48 hours of growth at $30^0$C. Pure isolates from the respective media were characterized and identified based on their morphological, biochemical and physiological features (Holt *et al.*,1994; Cheesbrough, 2006).

**Determination of nutrient components of Groundnut**

Healthy samples of groundnut seed were sent to the Food Science and Technology Laboratory for the determination of nutrient composition. The gravimetric alkaline precipitation method was used for phytochemical assessment. All experiments were done in triplicates in accordance with the methods of AOAC, (2005).

**Statistical analysis**

Data obtained were subjected to analysis of variance and Duncan multiple range test.

## RESULTS AND DISCUSSION

**Table 1: Bacterial isolates Present in Each of The FiveVarieties of Groundnut**

| Bacteria | SN10 | SN22 | SN23 | SN24 | LM |
|---|---|---|---|---|---|
| **Bacillus cereus** | + | - | + | - | - |
| **Micrococcus sp** | + | + | + | - | - |
| **Staphylococcus sp** | - | - | + | + | + |
| **Bacillus mycoides** | + | - | - | + | + |

**Table 2: Proximate Composition of Different Varieties of Groundnut**

| Variety | Moisture | Ash | Lipid | Fibre | CHO | Protein |
|---|---|---|---|---|---|---|
| SM 10 | 6.55±0.00$^{e}$ | 2.30±0.00$^{e}$ | 49.25±0.05$^{a}$ | 4.95±0.50$^{a}$ | 16.15±0.05$^{d}$ | 23.22±2.58$^{c}$ |
| SN 22 | 7.35±0.05$^{b}$ | 6.55±0.05$^{a}$ | 16.10±0.10e | 3.95±0.15$^{c}$ | 30.60±0.40$^{a}$ | 35.45±0.05$^{a}$ |
| SN 23 | 7.23±0.00$^{c}$ | 4.05±0.05$^{c}$ | 20.15±0.05d | 3.50±0.00$^{d}$ | 28.35±0.15$^{b}$ | 36.74±0.04$^{a}$ |
| SN 24 | 6.8±0.02$^{d}$ | 3.80±0.00$^{b}$ | 37.35±0.15b | 4.05±0.005$^{b}$ | 21.65±0.37$^{c}$ | 26.35±0.15$^{c}$ |
| LM | 7.8±0.00 $^{a}$ | 5.15±0.05$^{d}$ | 22.0±0.10c | 3.10±0.10$^{e}$ | 31.25±0.37$^{a}$ | 32.20±1.60$^{b}$ |

a, b, c … - Means in the same column with different superscripts are significantly different ($p<0.05$), CHO= carbohydrate

**Table 3: Mineral Composition of Five varieties of Groundnut.**

| Variety | Ca | Fe | Mg | P | K | Na |
|---|---|---|---|---|---|---|
| SN 10 | 92.10±0.00$^{b}$ | 4.60±0.00$^{a}$ | 1.66±3.00$^{b}$ | 376.50±0.50$^{a}$ | 705.50±0.50$^{b}$ | 18.50±0.50$^{d}$ |
| SN 22 | 102.50±0.50$^{e}$ | 4.25±0.05$^{b}$ | 161.00±1.00$^{b}$ | 316.50±5.50$^{c}$ | 508.00±0.00$^{e}$ | 20.00±0.00$^{c}$ |
| SN 23 | 120.25±0.25$^{d}$ | 4.25±0.05$^{c}$ | 1.65±0.00$^{b}$ | 360.00±0.00$^{b}$ | 700.00±0.00$^{c}$ | 107.30±87.70$^{a}$ |
| SN 24 | 130.00±0.00$^{c}$ | 4.70±0.00$^{a}$ | 49.00±1.00$^{a}$ | 200.00±0.00$^{d}$ | 950.00±0.00$^{a}$ | 3.20±0.00$^{e}$ |
| LM | 98.55±0.05$^{a}$ | 4.50±0.00$^{b}$ | 151.00±1.00$^{c}$ | 311.50±0.50$^{c}$ | 601.00±0.00$^{d}$ | 24.00±0.00$^{b}$ |

a, b, c … - Means in the same column with different superscripts are significantly different ($p<0.05$)
Ca= calcium, Fe= iron, Mg= magnesium, P= phosphorus, K= potassium, Na= sodium

A total of four bacteria (*Bacillus cereus, MicrococusSp, Staphylococcus sp and Bacillusmucoide)* were recovered from five varieties of groundnut (Table 1). SN10 had *Bacillus cereus, MicrococusSp, and Bacillus mucoide*, while*MicrococusSp* was the only detected in SN22. *Bacillus cereus, MicrococusSp, and Staphylococcus sp*were detected in SN23, whereas for SN24, *Staphylococcus* sp and *Bacillus mucoide*were detected. Groundnut from the Local Market had the presence of *Staphylococcus* sp *and Bacillus mucoide.*

Due to improper handling, processing and storage pattern, groundnuts and all its products are contaminated with microorganism. According to Abalaka and Elegbede (1981) isolated species of *Bacillus, Staphylococcus, Micrococcus*were also associated with the spoilage of groundnuts.

The groundnut sample collected were all found to be contaminated by fungi and bacteria. The bacteria species consistently isolated from the various varieties were *staphylococcus, micrococcus sp, bacillus cereus, and bacillus mycoides*.

The isolated bacteria species presence on these five varieties of groundnut are of particular interest due to the fact they have been recorded to be responsible for various infections. Some *Bacillus species*(*Bacillus cereus*)are food poisoning bacteria (Abalaka and Elegbede, 1981). These bacterial pathogens are ubiquitous in nature and as such could be found in soil, dust, and bodies of insects, animals and humans that comes in contactwith the groundnut and produce of it (Frazier andWesthoff, 1978). Sometimes transmission is done during storage, processing and some could be carried over from farm before harvest. In Nigeria, aflatoxin contamination in groundnuts is well above safe level (Oladele, 2014).

The parameter assessed in the proximate analysis of the different varieties of groundnut presented in Table 2; showed that the local groundnut obtained from the open market showed a higher significant value of (7.8± 0.00) while SN10 was significantly lower with a value of (6.55±0.00) for moisture content. While for Ash SN22 was significantly higher with a value of (6.55±0.05), while SN10 was significantly lower with a value of (2.30±0.00). The lipid analysis across the varieties showed that SN10 was significantly higher with a value of (49.25±0.05) while the lowest value of (16.10±0.10) was found in SN22. For the crude fiber the highest value of (4.95 ± 0.50) was recorded for SN10 while LM showed lower value of (3.10±0.10). CHO parameter assessed on the varieties showed significantly higher values in SN22 with value of (30.60 ± 0.40) while SN10 showed lower value of (16.15 ± 0.05). For protein, it showed that SN 23 was significantly higher with value of (36.74 ± 0.04), while SN10 showed lower value of (23.22 ± 2.58).
Data regarding moisture contents as presented in Table 3 showed highly significant differences for moisture contents among the different groundnut varieties. The highest moisture content was recorded in GLM (7.8±0.00), while SN10 recorded lowest value (6.55 ± 0.00) similar results were found by Chowdhury*et al.,* (2015) who found such variation in moisture content among different groundnut varieties. Moisture content in the seeds depends upon the maturity and quality of seeds. It also determines the ability of all seeds to be stored well.

Ash content of the five varieties of groundnut was variable and ranged from (2.30 ± 0.00 – 6.5 ± 0.5) as shown in Table 4.3 SN22 recorded highest value of (6.55 ± 0.05) while the lowest value was recorded for SN10 (2.30 ± 0.00). Atasie*et al.*,(2009) value has slight difference from these on their research. It might be because of the genetic variation among varieties. The lipid content in the groundnut varieties studied ranged from (49.25% -31.0%) as reported by ChukuandOkogbule, (2020) which agrees with the findings in this study. Lipid is a high energy density that promotes fat soluble vitamin absorption without adding to the bulk of the diet. Atasie*et al.*,(2009). Comparing the finding of the fibre content of this study to that of Atasie*et al.,* (2009) (3.7%) and Campos-Mondragon *et al.,* (2009), (3.3-4.4%) they are of close range to those reported in this study (4.95% - 3.1%) for SN10 and GLM respectively.

Carbohydrate content of the five varieties of groundnut was determined. As shown in Table 4.3, significantly highest amount of carbohydrate was recorded in SN22 (30.60 ± 0.40)0 while the lowest amount was recorded in SN10 (16.15 ± 0.05). This must have been affected by the

agronomics practices, environmental factors as well as variation among the varieties the present investigation was supported by the value of Asibuo,*et al.,* (2008). Protein in the five varieties of groundnuts showed that the highest amount was recorded for SN23 (36.74 ± 0.04) while SN10 recorded lowest amount (23.22 ± 2.58). The result from this study had also shown the observation that groundnut is rich in protein content. This might be accredited to genetic constitution; climate and varietal differences. The high protein content makes groundnut a good food supplement for man and livestock.

Table 3 showed the mineral composition of five varieties of groundnut. The highest value of (130.00±0.00) value was recorded for SN 24 while the lowest value was recorded for SN10 (92.10 ± 0.00). The highest value for Fe was recorded for SN24 (4.70 ± 0.00) while the lowest was recorded for SN22 and SN23 (4.25± 0.05) respectively. Mg content was highest in SN22 with value of (151.00 ± 1.00) while the lowest value was found in SN23 for (1.65 ± 0.00). Phosphorus content was highest (376.50 ± 0.50) in SN10 and lowest value of (200.00 ± 0.00) for SN 24.For Potassium (K) the highest value(950.00 ± 0.00) for SN24 while the lowest value of (508.00 ± 0.00) for SN22. Sodium (Na) content recorded highest value (107.30 ± 87.70) for SN 23 while the lowest value (3.20 ± 0.00) was recorded for SN24.
The mean values of the mineral composition for the five varieties of groundnut in this research are presented in Table 3. It has been shown that nut plays a major role in humans and animal nutrition especially as sources of vitamins and minerals (Wargovich, 2000). In the case of calcium (Ca) content from the difference varieties of the groundnut studied SN24 recorded highest amount (130.00 ± 0.00) while the lowest was recorded for SN10 (92.10 ± 0.00). The present investigation were supported by reported value of FAO and Atasie*et al,* (2009). Iron (Fe) content of the five varieties showed the highest value (4.25 ± 0.00) for SN22 & SN23 respectively. These might be due to the different level of Fe in soil and variation among the varieties. The present values were the same range with the reported values byAremu*et al.* (2006).

The result presented has shown that groundnut is a good source of oil, protein and mineral which can be used in diets to prevent against some mineral deficiencies. The sodium (Na) content obtained showed that SN23 recorded highest value (107.30 ± 81.70), while SN24 recorded lowest value (3.2 ± 0.00) and signifies that groundnut is one of the good source for electrolytes balance and controls high blood pressure in the body Yusuf *et al.,* (2007) and NRC, (1989).

## CONCLUSION

The five varieties of groundnut investigated in this study contained proximate and mineral nutrients. However, they still face the challenge of bacterial contamination. Therefore, strict hygienic measures should be adopted by farmers, traders and consumers to protect it from contamination.

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