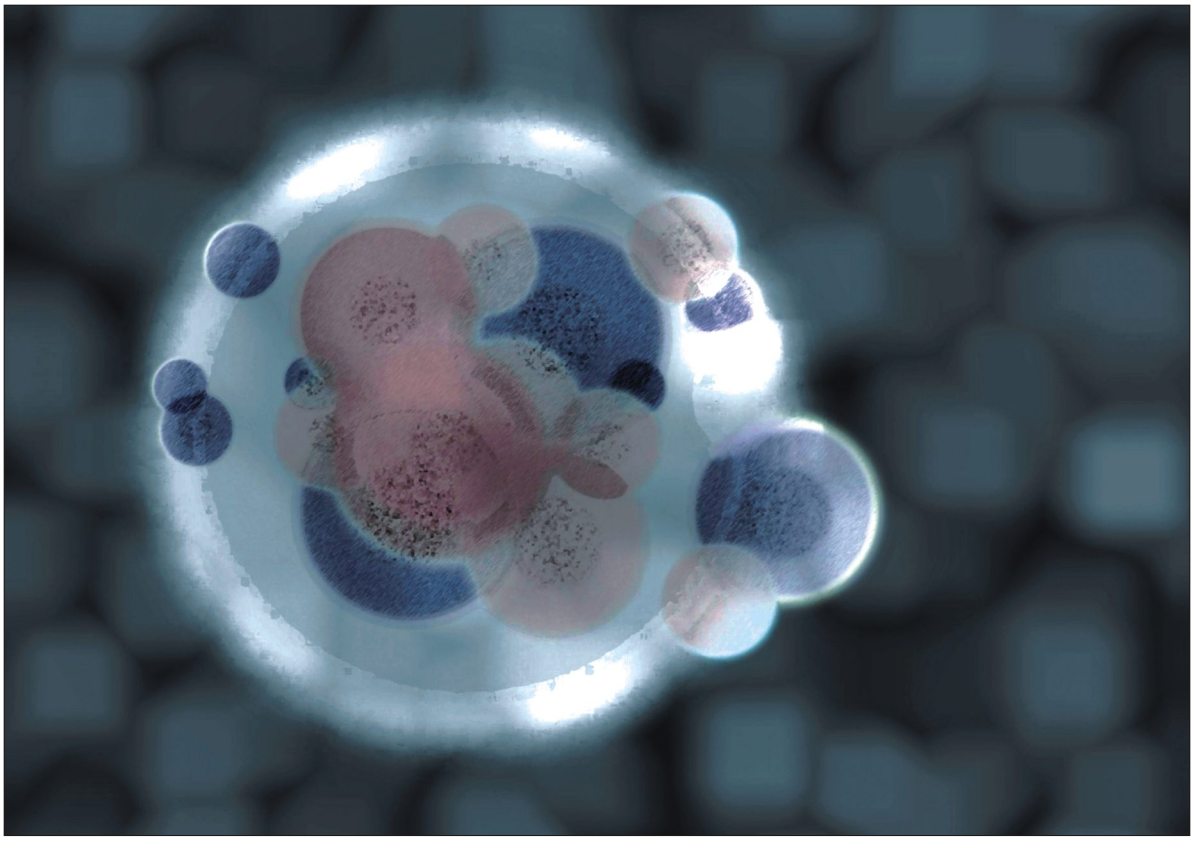

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# Research Article
# Proximate Composition and Aflatoxin Levels in Some Selected Grain Crops Sold in Taraba and Benue States, Nigeria

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## Abstract

**Background and Objective:** Crops sold in Nigeria has a great impact on health, different types of crops have varying nutritional values. Therefore, this study evaluated the proximate composition and total aflatoxins levels in some selected grain crops in Taraba and Benue states of Nigeria. The crops evaluated were maize, rice, groundnut and acha. **Materials and Methods:** Rice sample was procured from Vandeikya Local Government Area of Benue state, while other samples were purchased from Wukari market in Taraba state, Nigeria. Proximate compositions of the samples were determined by standard methods of the Association of Official Analytical Chemists, while total aflatoxins levels were carried out using the method of Enzyme Linked Immunosorbent Assay. Gross energy composition was determined using atwater factor. Means and the standard deviation of the results obtained were determined. **Results:** The mean moisture content determined for the samples were within safe level for storage with the range (9.00-10.25%), while the following ranges were determined for the following parameters: crude protein (7.58-25.83%), crude fibre (0.26-5.41%), ether extract (0.18-49.205%), ash (0.49-2.84%) and nitrogen free extract (17.66-88.36%). Aflatoxins were not detected in the samples except acha that had the value of 0.5 ppb. Gross energy compositions of the crops were between 395.40 and 614.01 kcal/100 g. **Conclusion:** This study has revealed the variation in nutritional composition of grain crops analysed. Aflatoxins were not detected in the grain crops analysed with the exception of acha that had 0.50 ppb which is less than the EU recommended levels for ready to eat products.

Key words: Cereal crops, nutritional composition, aflatoxins, gross energy, moisture content, immunosorbent, enzymes

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Cereal crops are members of the grass family grown for their edible starchy seed[1]. Africa has been known to be the centre of origin and also a major producer of several cereals like sorghum, pearl millet, finger millet, teff and African rice. Major cereals produced in Nigeria include rice, sorghum, maize and pearl millet[2]. Maize is also known as corn, it is a large grain plant first domesticated mostly in the northern part of Nigeria. Maize has become a staple food in many parts of the world, with total production surpassing that of wheat or rice[3].

Rice is the seed of the grass species *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice). It is the most widely consumed staple food for a large part of the world's human population especially in Nigeria. Rice is the most important grain with regard to human nutrition and caloric intake, providing more than one-fifth of the calories consumed worldwide by humans. There are many varieties of rice and culinary preferences tend to vary regionally. In Nigeria, Abakaliki rice is cultivated thrice a year[4]. Acha (*Digitaria exilis* and *D. iburua*) is probably the oldest African cereal. For thousands years, it has been cultivated across the dry Savannas. In fact, it was once their major food. Even though few other people have never heard of it, this crop still remains important in areas scattered from Cape Verde to Lake Chad. In certain regions of Mali, Burkina Faso, Guinea and Nigeria, for instance, it is either the staple or a major part of the diet. Each year West African farmers devote approximately 300,000 ha to cultivating fonio and the crop supplies food to 3-4 million people[5]. Groundnut, also known as peanut and goober, is taxonomically classified as *Arachis hypogaea*, which is a legume crop grown mainly for its edible seeds. It is widely grown in the tropics and subtropics, being important to both small and large commercial producers. It is classified as both grain legume, because of its high oil content, it is referred to as oilseed crop.

Aflatoxins are a family of toxins produced as secondary metabolite by certain fungi that are found on agricultural crops such as; maize (corn), peanuts, cottonseed and tree nuts[6]. The main fungi that produce aflatoxins are *Aspergillus flavus* and *A. parasiticus*, which are abundant in warm and humid regions of the world. Aflatoxin-producing fungi can contaminate crops in the field, at harvest and during storage[7]. Solving Nigeria's food problems is an indirect and powerful approach to alleviate poverty and improve the standard of living for Nigerian farmers and the populace. Hence, the aim of this study was to evaluate the nutritional compositions and quality (aflatoxins-free) of some selected grain crops (rice, acha, groundnut and maize) produced and sold in some Nigerian markets.

## MATERIALS AND METHODS

**Procurement of samples:** This study was carried out in 2017. Clean samples of white acha, groundnut and maize samples were purchased from Wukari market in Taraba state, Nigeria and clean rice sample (locally referred to as election variety in Benue and Taraba states) was procured from Vandeikya local government council rice mill in Vandeikya, Benue state, Nigeria. These samples were milled into fine powdered forms of 48 mesh size, 0.3 mm sieve size and packaged in polythene bag prior to analysis.

**Proximate analysis:** The proximate composition of maize, rice, groundnut and acha flour were determined by the standard methods of AOAC[8]. Carbohydrate was determined by difference:

100-Sum of the content of crude protein, crude fibre, ether extract and ash

Gross energy composition was calculated using the methods of AOAC[8]:

Fat×9+carbohydrate×4+protein×4 kcal/100 g

**Aflatoxin analysis:** Enzyme linked immunosorbent assay (ELISA) technique was used to determine the total aflatoxins in the samples described by Weiland[9]. The samples obtained were ground in a blender and 5 g of the sample was measured, 25 mL of 70/30 (v/v) methanol/water solution was added to the sample for extraction and the filtrate was collected after filtration. The 200 µL of conjugate was pipetted into dilution wells followed by 100 µL of standard and 100 µL sample and each well was mixed carefully, immediately, 100 µL of contents were transferred from each dilution well into a corresponding antibody coated micro well. It was then incubated at 30°C for 15 min, each content of the micro well strips was then emptied into waste container and washed by filling with distilled water and then dumping the water from the micro well strips. The 100 µL of the substrate was pipetted into each micro well strip and incubated at 30°C for 5 min after which a blue colour was developed, 100 µL of stop solution was measured using a 100 µL pipette and dispensed into each micro well strip. On adding stop solution, colour changed from blue to yellow, the content in the micro well were then read using ELISA reader calibrated curve by Weiland[9].

**Statistical analysis:** Means and standard deviation of the results obtained were determined. Means of triplicate results were used.

## RESULTS

**Proximate composition:** Table 1 shows the proximate composition of the samples analyzed with the range (9.00±0.01 to 10.25±0.01) for the Moisture Content (MC) determined which was within safe levels for storage. No definite trend was observed in the proximate values obtained in this study.

**Gross energy composition:** The values of gross energy composition of the samples as shown in Table 2 was analyzed theoretically by using the values obtained for carbohydrates, proteins and lipids for all samples.

**Aflatoxins level:** Aflatoxin was not detected in maize, rice and groundnut samples analysed. This shows the level of cleanliness/wholesomeness and non-contamination of these samples (Table 3).

## DISCUSSION

The ash fraction is indicative of mineral content present in the grains samples analysed which was found to be within the range of 0.49-2.84%. This finding is similar to 2% as reported by Oko *et al.*[10] and also falls within the values of 1-6% as reported by Ballogou *et al.*[11]. However, the values obtained for groundnut, maize and rice in this study were lower than the average value of 3.5% reported by Jideani[12].

The values of crude protein in this study were within the range of 7.58-25.83%, the lowest value was found in acha while the highest was obtained in groundnut. The maize samples were observed to be 11.70%. The findings in this study were below the range of 1.58-7.94% obtained[10] who worked with different varieties of rice samples. Also, the observed result of acha in this study is slightly above 5.1-11% as reported by Ballogou *et al.*[11].

The crude fibre (%) of the samples analyzed were within the range 0.26-5.41%. The value obtained for rice in this study is above the values 1.0-2.5% obtained[11] who worked on several varieties of rice. However, the values obtained for white acha in this study was very close to 0.41% as reported by Ballogou *et al.*[11]. The value determined for groundnut in this study was higher than the value of 3.7% reported by Atasie *et al.*[13], who also worked on groundnut.

The values of crude lipid in this study were within the range 0.18-49.2%. The value of crude lipid in groundnut obtained in this study was higher than 47% gotten by Jideani[12]. This could be due to the environmental/climatic factors coupled with varietal differences of samples analyzed. The value of crude lipid obtained for acha in this study is in line with the range of 1.3-5.2% as obtained in other research[11].

Table 1: Proximate composition of some selected grain crops on Dry Matter (DM) basis (%)

| Samples | Moisture content | Ash | Crude lipid | Crude fibre | Crude protein | Carbohydrates (NFE) |
|---|---|---|---|---|---|---|
| Maize | 9.40±0.02 | 0.49±0.01 | 0.18±0.01 | 0.26±0.01 | 11.70±0.01 | 87.37±0 02 |
| Rice (election variety) | 9.00±0.01 | 2.84±0.01 | 4.11±0.01 | 1.50±0.01 | 9.44±0.01 | 82.11±0.04 |
| Groundnut | 9.75±0.01 | 1.90±0.01 | 49.20±0.01 | 5.41±0.01 | 25.83±0.01 | 17.66±0.04 |
| Acha | 10.25±0.01 | 1.70±0.01 | 1.93±0.01 | 0.43±0.01 | 7.58±0.01 | 88.36±0.04 |

Results represent Mean±SD (n = 3)

Table 2: Energy composition of maize, election rice, groundnut and acha in kcal/100 g and kJ/100 g

| Samples | Energy (kcal/100 g) | Energy (kJ/100 g) |
|---|---|---|
| Maize | 395.40±0.01 | 1659±0.02 |
| Rice | 400.46±0.03 | 1682±0.01 |
| Groundnut | 614.01±0.04 | 2579±0.10 |
| Acha | 401.91±0.04 | 1688±0.03 |

Results represent Mean±SD (n = 3)

Table 3: Levels of total aflatoxins in maize, rice, groundnut and acha (ppb)

| Samples | Aflatoxin (ppb) | Inference |
|---|---|---|
| Maize | ND | Absent |
| Election rice | ND | Absent |
| Groundnut | ND | Absent |
| Acha | 0.50±0.00 | Present |

ND: Not detected, Results represent Mean±SD (n = 3)

The percentage moisture content of maize obtained was 9.40%, rice (election variety) 9.00%, groundnut 9.75% and acha 10. 25%. The moisture content of groundnut 9.75% was higher than 5.8% as obtained in previous study[11]. The values of MC obtained in this study were within safe moisture levels of below 14% for storage of as determined by Agriculture and Horticulture Development Board[14], hence, the samples can be stored safely for some months if stored in appropriate storage conditions.

Aflatoxin was not detected in maize, rice and groundnut samples analysed. This implies the level of cleanliness/wholesomeness and non-contamination of these samples. However the level of aflatoxin in acha was detected to be 0.50 ppb which was below EU recommendation for ready-to-eat food which is 4 ppb. This is indicative of the quality of acha samples analysed in this study. The findings in this study can be applied to other future analysis involving similar analysis carried out in this study. Based on the findings, further work with expanded scope should be carried out with the view of reducing the limitations experienced in this study such as limited number of cereal and leguminous grains analyzed.

## CONCLUSION

This study has revealed variation in nutritional composition of grain crops analyzed. These differences could be due to their genetic and environmental/climatic factors. However, aflatoxin was not detected in the grain samples except for acha with 0.50 ppb of aflatoxin which is below 2.0 ppb, the European Union recommended level, hence safe for human/animal consumption.

## SIGNIFICANCE STATEMENT

This study discovered the nutrient levels and energy composition of some food crops, such as maize, rice, groundnut and acha in Wukari and Vandeikya in Taraba and Benue States, respectively. Also, the levels of aflatoxins were revealed. This information would be beneficial to consumers who hitherto did not know the food composition of samples analysed.

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