# "Comparative Evaluation of the Nutritional Composition and Antioxidant Properties of Selected Indigenous Foods in Bauchi State, Nigeria"

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https://doi.org/10.56201/rjfsqc.vol.12.no7.2026.pg75.89

***Abstract***
*Indigenous foods are important components of traditional diets in Bauchi State, Nigeria, providing energy, protein, minerals, dietary fibre, and potentially beneficial antioxidant compounds. This study examines the nutritional composition and antioxidant properties of selected indigenous foods using published research findings. A secondary-data approach was adopted to synthesize evidence on traditional foods consumed in Bauchi State and antioxidant studies involving indigenous Nigerian foods. Published nutritional data indicate that dambun naman rago contained 49.31% protein, awara contained 16.86% protein, miyan karago contained 11.40% protein, and chanchangan dawa contained 6.43% protein. Research on indigenous Nigerian vegetables has also demonstrated free-radical-scavenging activity, with differences among vegetable extracts. However, the available studies did not measure the nutritional composition and antioxidant properties of all the selected Bauchi foods under the same experimental conditions. Therefore, the findings support the nutritional importance of indigenous foods but do not establish a definitive antioxidant ranking among the selected Bauchi foods. Further laboratory investigation using standardized proximate analysis, total phenolic content determination, and antioxidant assays is recommended. The study highlights the importance of documenting indigenous food composition to support dietary planning, food science research, and the preservation of local food resources.*

***Keywords:*** *Indigenous foods, nutritional composition, antioxidant properties, proximate analysis, Bauchi State, Nigeria.*

## Introduction

### Background to the Study

Food provides the nutrients required for growth, energy production, tissue repair, and maintenance of good health. The nutritional quality of a diet depends on its content of carbohydrates, proteins, fats, vitamins, minerals, and other biologically active compounds. In Nigeria, indigenous foods contribute substantially to household nutrition and reflect local agricultural resources, cultural practices, and traditional food-processing methods. Bauchi State has a diverse food culture involving cereal-based meals, legumes, vegetables, soups, and animal products. Examples include dambu, danwake, chanchangan dawa, miyan karago, and awara. A study by Sosanya et al. (2021) examined the proximate and mineral composition of 31 traditional composite foods consumed in rural areas of Bauchi State. The researchers identified several foods with notable protein and mineral contents. Apart from conventional nutrients, many plant-based foods contain antioxidant compounds, including phenolic acids, flavonoids, carotenoids, and certain vitamins. These compounds can participate in reactions that neutralize free radicals under laboratory conditions. Their concentrations and measured antioxidant activities vary according to plant species, maturity, processing, extraction methods, and storage. Research by Oluwaniyi et al. (2017) examined the proximate composition and antioxidant activity of six indigenous Nigerian vegetables. All six extracts demonstrated measurable radical-scavenging activity, although the strength of activity differed among the vegetables. Despite existing research, nutritional measurements and antioxidant findings are not consistently available for the same indigenous foods in Bauchi State. Comparative assessment is therefore useful for identifying nutrient-rich foods and determining which foods warrant further laboratory investigation.

### Statement of the Problem

Indigenous foods are widely consumed in Bauchi State and may provide important nutrients and bioactive compounds. However, scientific information about their nutritional composition and antioxidant properties remains uneven across different food types.

Although previous research has investigated the nutrient composition of traditional foods in Bauchi State, fewer studies have evaluated both nutritional composition and antioxidant properties in the same food samples using standardized laboratory methods. This limits the ability to make reliable comparisons among foods and determine how their nutritional profiles relate to their measured antioxidant activities. Furthermore, variations in food ingredients, processing, cooking methods, and storage conditions may influence nutrient retention and the concentrations of antioxidant compounds. Without consistent analytical procedures, findings from different studies may be difficult to compare. This study therefore addresses the need to compare available evidence on the nutritional composition and antioxidant properties of selected indigenous foods in Bauchi State and to identify the need for further standardized laboratory evaluation.

### Aim and Objectives of the Study

The aim of this study is to comparatively evaluate the nutritional composition and antioxidant properties of selected indigenous foods in Bauchi State, Nigeria.

### Specific Objectives

The specific objectives are to:

1. Identify selected indigenous foods commonly consumed in Bauchi State, Nigeria.
2. Determine and compare the proximate nutritional composition of the selected foods using

available scientific data.
3. Examine the reported mineral composition of the selected foods.
4. Review the available evidence on the antioxidant properties of the selected foods.
5. Compare the nutritional and antioxidant characteristics of the foods based on available findings.
6. Identify gaps in existing research and recommend areas for further investigation.

**Significance of the Study**

The findings of this study may be beneficial to several groups.

**Consumers:** The study may increase awareness of the nutritional contributions of indigenous foods and encourage dietary diversity.

**Nutritionists and dietitians:** The findings may provide useful background information for dietary planning and the promotion of locally available food resources.

**Food scientists:** The study may identify indigenous foods that warrant further investigation of their nutrient composition and antioxidant properties.

**Researchers and students:** The work may serve as a reference for future studies on food composition, traditional diets, and bioactive compounds in Nigerian foods.

**Public health professionals:** The findings may support nutrition education and the promotion of diverse, nutrient-rich traditional diets, while recognizing that laboratory antioxidant activity alone does not establish clinical health benefits.

**Food producers and policymakers**: The study may contribute to the documentation, preservation, and potential development of traditional food products.

**Scope of The Study**

The study focuses on selected indigenous foods consumed in Bauchi State, Nigeria. These may include dambu, awara, danwake, miyan karago, chanchangan dawa, and other traditional foods for which suitable scientific information is available. The nutritional assessment covers proximate components such as moisture, ash, crude protein, crude fat, crude fibre, and carbohydrates, as well as reported mineral composition. The antioxidant component considers available findings from recognized assays, including DPPH, ABTS, FRAP, and total phenolic content determination, where relevant data exist. For this literature-based version of the project, the assessment relies on previously published research rather than newly conducted laboratory experiments. Consequently, comparisons are Limited to The Measurements and Methods Reported in The Available Literature.

**Literature Review**

**Introduction**

Literature reviews relevant literature on the nutritional composition and antioxidant properties of indigenous foods, with particular reference to foods consumed in Bauchi State, Nigeria. It discusses the concept and importance of indigenous foods, their contribution to human nutrition, the major components of food composition, the nature and significance of antioxidants, methods used to evaluate antioxidant activity, factors affecting nutritional quality, and previous studies on traditional foods in Nigeria. The chapter also identifies gaps in existing knowledge that justify the comparative evaluation of selected indigenous foods.

Indigenous foods are important components of traditional diets and may contribute to dietary diversity, food security, and the preservation of local food cultures. Their nutritional characteristics vary according to food type, variety, growing conditions, harvesting practices, processing, and

storage. In addition to providing essential nutrients, some indigenous foods contain naturally occurring bioactive compounds that exhibit antioxidant activity in laboratory tests. A comprehensive evaluation of both nutritional composition and antioxidant properties is therefore useful for understanding the potential dietary value of these foods.

**Concept of Indigenous Foods**

Indigenous foods are food resources that have historically been cultivated, gathered, reared, processed, or consumed within particular geographical areas and cultural communities. They may include cereals, legumes, vegetables, fruits, roots, tubers, nuts, seeds, herbs, spices, and traditional food preparations. Their use is often associated with local knowledge of agriculture, food preservation, preparation techniques, and dietary practices.

In Nigeria, indigenous foods form an important part of the diets of different ethnic and cultural groups. Common examples include millet, sorghum, cowpea, groundnut, leafy vegetables, traditional fruits, and foods prepared from locally available agricultural products. The particular foods consumed vary according to geographical location, climate, agricultural production, market availability, and cultural preferences. Indigenous foods are important because they may be readily available, culturally acceptable, and suitable for local production. Their use can support smallholder farmers, local markets, food processors, and household food security. Furthermore, many traditional food crops are adapted to local environmental conditions and may contribute to agricultural biodiversity. However, the term indigenous food does not necessarily mean that a food is nutritionally superior to all other foods. Nutritional value must be established through appropriate analysis and consideration of the food's preparation, quantity consumed, digestibility, and contribution to the overall diet. Scientific assessment is therefore necessary to determine the nutritional characteristics of individual indigenous foods and compare their potential dietary contributions.

**Indigenous Foods in Bauchi State, Nigeria**

Bauchi State is located in northeastern Nigeria and has diverse agricultural activities and food traditions. Cereals, legumes, vegetables, and other locally available food resources contribute to food consumption across the state. The types and quantities of foods consumed may differ between rural and urban communities because of differences in agricultural production, income, market access, seasonal availability, and household food preferences. Cereal grains such as millet and sorghum are important food resources in many parts of northern Nigeria. They provide carbohydrates and varying quantities of protein, fibre, minerals, and other constituents. Legumes, including cowpea, are valuable sources of plant protein and may complement cereal-based diets. Groundnut contributes fats, protein, and other nutrients, while leafy vegetables may provide vitamins, minerals, fibre, and phytochemicals. The nutritional value of these foods depends on their individual characteristics and how they are processed and consumed. For example, dehulling, soaking, fermentation, cooking, and drying can alter nutrient concentrations, digestibility, antinutritional factors, and the availability of certain bioactive compounds. Therefore, the nutritional characteristics of raw food samples may differ from those of the prepared foods actually consumed by households. Research on traditional diets in Bauchi State has examined the nutrient composition of locally consumed foods, providing a useful foundation for further investigations. Sosanya and colleagues reported work on the characterization and nutrient components of traditional foods and diets in rural areas of Bauchi State. Such research demonstrates the importance of analysing foods within their local dietary context. Further comparative assessment

of selected individual foods, particularly when antioxidant parameters are included, may provide additional information about their nutritional and functional characteristics.

**Nutritional Composition of Indigenous Foods**

Nutritional composition refers to the amounts of nutrients and other chemical constituents present in a food. The nutritional value of indigenous foods is commonly assessed through proximate analysis, with additional measurements of minerals, vitamins, and selected bioactive compounds where appropriate.

**1 Moisture Content**

Moisture content represents the amount of water present in a food sample. It is an important parameter because water content influences food texture, weight, stability, and susceptibility to microbial growth. Foods with high moisture content are generally more perishable than foods with low moisture content, although water activity, acidity, processing, and storage conditions also determine food stability. Indigenous foods such as fresh vegetables and fruits often contain considerable amounts of water, whereas dried cereals, grains, and legumes generally have lower moisture contents. Drying is commonly used to extend the shelf life of these foods and facilitate storage and transportation. Moisture content is commonly determined by drying a weighed food sample under specified conditions until a constant mass is obtained, using an appropriate validated method. The results are useful when comparing the composition of food samples, particularly because differences in moisture content can affect the apparent concentrations of other nutrients expressed on a wet-weight basis.

**2 Crude Protein**

Protein is an essential macronutrient required for growth, tissue repair, enzyme production, hormone synthesis, and immune function. Indigenous foods provide protein in different quantities and qualities depending on their botanical or animal origin.

Legumes such as cowpea and groundnut are important sources of plant protein in Nigerian diets. Cereals such as millet and sorghum also contain protein, although their amino acid profiles differ from those of legumes. Combining cereals and legumes can improve the overall amino acid balance of a meal because the two food groups have complementary amino acid profiles.

Crude protein is commonly estimated by determining the nitrogen content of a food sample and multiplying it by an appropriate nitrogen-to-protein conversion factor. The Kjeldahl method is one established approach used for this purpose. However, crude protein measurements do not directly indicate protein digestibility or amino acid quality, and the choice of conversion factor can influence the estimated result.

**3 Crude Fat**

Crude fat represents the lipid fraction extracted from a food sample using an appropriate analytical procedure. Fat provides concentrated dietary energy, supplies essential fatty acids, supports cell membrane structure, and facilitates the absorption of fat-soluble vitamins.

Indigenous foods vary in their fat contents. Groundnuts and certain oilseeds are relatively rich in lipids, whereas most cereal grains contain lower quantities of fat. Traditional processing methods, including roasting, frying, and oil extraction, may alter the fat content and composition of foods.

Fat content can be determined using solvent extraction methods, such as Soxhlet extraction, where suitable. The measured crude fat fraction depends on the extraction conditions and may not include every lipid compound present in the sample.

**4 Crude Fibre**

Crude fibre is an operational measure of the fibrous residue remaining after a food sample undergoes specified chemical digestion procedures. It provides a conventional estimate of certain structural plant components, although it does not represent the total dietary fibre content of a food. Dietary fibre is associated with normal bowel function and may contribute to improved satiety and favourable metabolic outcomes. Indigenous foods such as whole grains, legumes, and leafy vegetables can contribute fibre to the diet. The quantity retained in a food depends on factors such as the edible portion, milling, dehulling, cooking, and other processing operations.

Crude fibre can be determined through sequential acid and alkali digestion followed by the measurement of the remaining residue, with correction for ash where required. Since crude fibre methods underestimate some forms of dietary fibre, total dietary fibre analysis may be more appropriate when the specific objective is to quantify dietary fibre intake.

**5 Ash Content**

Ash content is the inorganic residue remaining after a food sample is incinerated under specified conditions. It is commonly used as an approximate indicator of the total mineral residue in food, although it does not identify individual minerals or establish their bioavailability.

Indigenous foods may contain minerals such as calcium, iron, magnesium, potassium, zinc, and phosphorus. These minerals are important for bone formation, oxygen transport, energy metabolism, muscle function, and numerous enzymatic processes.

Ash content is generally determined by weighing a food sample before and after incineration in a suitable furnace. Individual minerals require separate analytical procedures, such as atomic absorption spectrometry, inductively coupled plasma techniques, or validated colorimetric methods.

**6 Carbohydrate Content**

Carbohydrates are important sources of dietary energy and are major constituents of cereal-based foods. Millet, sorghum, maize, and many root and tuber crops provide substantial quantities of carbohydrates. Carbohydrate content in proximate analysis is frequently estimated by difference, in which the measured percentages of moisture, protein, fat, ash, and crude fibre are subtracted from 100. Depending on the analytical convention used, crude fibre may be included in the calculation or reported separately. The calculation method must therefore be clearly stated to ensure valid comparisons.

Carbohydrate values estimated by difference can accumulate the errors associated with the other measurements and should not automatically be interpreted as directly measured available carbohydrate.

**Antioxidants and Their Importance in Foods**

Antioxidants are substances that can inhibit or slow oxidation through various chemical mechanisms. In biological systems, antioxidant defence involves enzymes, endogenous molecules, and dietary compounds that help maintain the balance between reactive species and protective mechanisms. Reactive oxygen species are generated during normal cellular metabolism and can

also arise from environmental exposures and other processes. When their production exceeds the capacity of antioxidant defence systems, oxidative stress may occur. Excessive oxidative stress can damage cellular components, including lipids, proteins, and DNA, and has been associated with several chronic disease processes. Foods contain different naturally occurring compounds that may participate in antioxidant reactions. These include phenolic compounds, flavonoids, carotenoids, and certain vitamins. Their concentrations depend on the type of food, genetic characteristics, maturity, cultivation conditions, and processing methods. it is important to distinguish antioxidant activity measured in laboratory assays from health outcomes in humans. A high antioxidant result in a chemical test does not necessarily mean that the food will prevent a disease or produce a particular therapeutic effect. Digestion, absorption, metabolism, and interactions with other dietary components influence the biological effects of food constituents.

## Major Antioxidant Compounds in Indigenous Foods

### 1 Phenolic Compounds

Phenolic compounds are naturally occurring plant constituents characterised by one or more hydroxyl groups attached to aromatic rings. They include phenolic acids, flavonoids, tannins, and other related compounds. Many are investigated because they can participate in oxidation-reduction reactions and interact with free radicals.

Phenolic compounds occur in different parts of plants, including seeds, grain coverings, leaves, fruits, and roots. Their concentrations vary according to plant species, variety, maturity, growing conditions, and processing. Some phenolic compounds may also influence the colour, taste, and astringency of foods. Total phenolic content is commonly estimated using the Folin–Ciocalteu method. Results are frequently expressed as milligrams of gallic acid equivalents per gram of sample or extract. However, the method measures overall reducing capacity and can respond to certain non-phenolic substances; therefore, it should not be interpreted as a precise measurement of every individual phenolic compound (Prior et al., 2005).

### 2 Flavonoids

Flavonoids are a major class of plant polyphenols found in various vegetables, fruits, legumes, seeds, and other plant foods. Examples include quercetin, catechin, and kaempferol. Their structures differ, and these differences influence their chemical behaviour and potential antioxidant activity. Flavonoids are studied for their ability to participate in free-radical scavenging and other oxidation-reduction reactions. Their presence in indigenous foods may contribute to the overall antioxidant activity of food extracts. However, the quantity and biological availability of individual flavonoids vary substantially among foods. Total flavonoid content is often determined using an aluminium chloride colorimetric assay, with results expressed as equivalents of a reference compound, such as quercetin or catechin. The choice of reference standard and analytical conditions should be reported because they affect the interpretation and comparability of results.

### 3 Carotenoids

Carotenoids are naturally occurring pigments responsible for yellow, orange, and red colours in many fruits and vegetables. Important examples include beta-carotene, lutein, and lycopene. Some carotenoids, particularly beta-carotene, can serve as precursors of vitamin A.

Carotenoids can participate in antioxidant reactions, although their activity depends on the chemical environment, concentration, and surrounding food matrix. Their occurrence in indigenous foods may be influenced by plant variety, maturity, storage, and cooking practices.

Carotenoids require appropriate analytical procedures, often involving solvent extraction and spectrophotometric or chromatographic techniques. They should not be assumed to have been quantified merely because total phenolic content and DPPH activity have been measured.

**4 Vitamins with Antioxidant Functions**

Certain vitamins, particularly vitamins C and E, contribute to antioxidant functions in the body. Vitamin C is water-soluble and can participate in reactions involving reactive species, whereas vitamin E comprises fat-soluble compounds that help protect lipids from oxidation.

Some indigenous fruits and vegetables may provide vitamin C, while oilseeds and other lipid-containing foods may provide vitamin E. However, the concentrations depend on the particular food and may be affected by drying, heating, exposure to oxygen, and storage.

Vitamin analysis requires specific validated procedures. Although vitamin concentrations may be associated with antioxidant activity, they cannot be accurately inferred from a general antioxidant assay alone.

**Methods for Evaluating Antioxidant Properties**

The antioxidant properties of foods are commonly investigated through chemical assays that measure particular aspects of antioxidant behaviour. Because the assays operate through different reaction mechanisms, the use of more than one method can provide a more comprehensive assessment (Prior et al., 2005; Munteanu and Apetrei, 2021).

**1 DPPH Free-Radical-Scavenging Assay**

The 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay is widely used to evaluate the free-radical-scavenging activity of plant and food extracts. DPPH is a relatively stable radical that produces a characteristic purple colour. When an antioxidant reacts with the radical, the colour intensity decreases. The reduction in absorbance is measured spectrophotometrically and used to estimate the scavenging activity of the sample. Results may be reported as percentage inhibition at a specified concentration or as an inhibitory concentration, such as $IC_{50}$, when an appropriate concentration-response analysis is performed. The DPPH assay is comparatively simple and useful for screening food extracts. However, the results depend on extraction solvents, reaction time, sample concentration, and other analytical conditions. The assay does not directly establish antioxidant effects in the human body.

**2 ABTS Radical-Cation-Scavenging Assay**

The ABTS assay measures the ability of compounds in a sample to reduce the coloured ABTS radical cation. Antioxidants react with the radical, producing a reduction in colour intensity that can be monitored spectrophotometrically. The assay can be applied to a range of food extracts and is frequently used to compare the antioxidant capacities of fruits, vegetables, grains, and other food materials. Results may be expressed as Trolox equivalents when an appropriate calibration procedure is used. Although ABTS and DPPH both evaluate radical-scavenging behaviour, they differ in their reaction characteristics and responses to individual compounds. Results obtained using the two methods should therefore be interpreted separately rather than assumed to be interchangeable.

**3 Ferric-Reducing Antioxidant Power (FRAP) Assay**

The FRAP assay evaluates the capacity of compounds in a sample to reduce ferric ions to ferrous ions under specified conditions. The reaction produces a coloured complex whose absorbance is measured spectrophotometrically.

FRAP is useful for comparing the reducing capacity of food extracts. However, it measures a particular aspect of antioxidant behaviour and may not capture all mechanisms involved in radical scavenging. The combined use of FRAP and a radical-scavenging assay can provide complementary information about the antioxidant properties of selected indigenous foods. The choice of methods should be guided by the study objectives, laboratory resources, and the validated procedures available.

**4 Determination of Total Phenolic Content**

The Folin–Ciocalteu method is widely used to estimate the total phenolic content of plant-derived foods and extracts. Under alkaline conditions, reducing substances react with the reagent to produce a blue-coloured complex. The intensity of the colour is measured spectrophotometrically and compared with a calibration curve prepared using a reference standard, commonly gallic acid. The method is useful for comparing samples under consistent analytical conditions. Nevertheless, some non-phenolic reducing substances can contribute to the response. Consequently, the results are best described as total phenolic content estimated by the Folin–Ciocalteu method rather than a direct measurement of all individual phenolic molecules (Prior et al., 2005).

**Factors Affecting Nutritional Composition and Antioxidant Properties**

Several factors influence the nutritional and antioxidant characteristics of indigenous foods.

**1 Genetic and Varietal Differences**

Different species and varieties of the same food crop may have different concentrations of protein, fat, minerals, phenolic compounds, and other constituents. Genetic variation can influence grain colour, seed size, pigment content, and the distribution of nutrients among plant tissues.

Consequently, food samples identified only by a general name may still differ considerably in composition. Proper identification of food species and varieties is important for meaningful comparisons.

**2 Environmental and Agricultural Conditions**

Soil composition, rainfall, temperature, sunlight, and farming practices can influence plant growth and nutrient accumulation. Mineral concentrations in crops may be affected by the availability of elements in the soil, while environmental stress can influence the production of certain plant secondary metabolites. Differences in agricultural conditions may therefore contribute to variation in the nutritional and antioxidant properties of foods obtained from different locations.

**3 Maturity and Harvesting**

The maturity stage at harvest can affect nutrient and phytochemical concentrations. Changes during plant development may influence moisture, carbohydrate accumulation, pigments, vitamins, and phenolic compounds.

Harvesting practices and the time between harvesting and analysis can also influence sample quality. Standardised collection and preparation procedures help reduce unwanted variation.

**4 Processing and Cooking**

Processing methods such as soaking, fermentation, boiling, roasting, frying, drying, and milling can alter food composition. Heating may reduce certain heat-sensitive vitamins, while processing may improve the accessibility of some nutrients or release compounds from plant tissues.

Fermentation may also modify antinutritional factors and the availability of certain nutrients. In other cases, dehulling and milling may remove portions of the grain or seed that contain fibre, minerals, and phenolic compounds.

The effects of processing are not always uniform. They depend on the food type, processing conditions, and analytical method. Therefore, samples should be prepared consistently if their composition is to be compared fairly.

**5. Storage Conditions**

Storage conditions, including temperature, humidity, light exposure, and oxygen availability, may affect nutrient retention and antioxidant activity. Prolonged or inappropriate storage can lead to oxidation of lipids, degradation of vitamins, moisture changes, and deterioration of food quality.

Appropriate storage, sample labelling, and prompt analysis are therefore necessary to improve the reliability of laboratory findings.

**Empirical Review of Previous Studies**

**1 Sosanya et al. (2021): Traditional Foods in Bauchi State**

Sosanya et al. (2021) investigated the nutrient composition of traditional foods and diets consumed in rural areas of Bauchi State, Nigeria. The researchers analysed 31 traditional composite foods for proximate composition and selected minerals, including iron, zinc, copper, and calcium. Their analyses were conducted using established analytical procedures.

The study found considerable differences in nutrient composition among the foods examined. For example, dambun naman rago had a reported protein content of 49.31%, while miyan karago contained 11.40% protein per 100 g of soup. Certain foods prepared from combinations of cereals, legumes, and vegetables also provided appreciable quantities of selected minerals.

The researchers concluded that traditional foods consumed in rural Bauchi communities include foods with useful nutritional profiles. Their work is particularly relevant to the present study because it establishes a local evidence base for evaluating traditional foods and demonstrates the value of laboratory analysis in understanding their nutritional contribution.

However, the main focus of that investigation was the proximate and mineral composition of traditional composite foods. The present study seeks to extend the comparative assessment to the antioxidant properties of selected indigenous foods alongside their nutritional composition. The exact distinction will depend on the food samples and analytical parameters selected for the current research.

**2 Ene-Obong et al. (2018): Indigenous Spices in Nigeria**

Ene-Obong et al. (2018) investigated the chemical composition and antioxidant activities of seven indigenous spices consumed in southern Nigeria. The researchers analysed the nutrient and phytochemical composition of the spices and assessed antioxidant activity using DPPH radical-scavenging and FRAP assays. The results showed that the spices differed in their nutritional composition and antioxidant characteristics. Ricinodendron heudelotii had the highest reported protein and fat contents among the samples, while Aframomum citratum showed the highest total phenolic and flavonoid contents and DPPH scavenging activity. Afrostyrax lepidophyllus

demonstrated the strongest reducing capacity according to the FRAP assay. The study demonstrated that different indigenous food materials can vary substantially in their nutritional composition and laboratory-measured antioxidant activity. It also showed the usefulness of combining nutrient analysis with more than one antioxidant assay.
Although the study focused on spices from southern Nigeria, its analytical approach is relevant to research on indigenous foods in Bauchi State. Differences in geographical location and food types mean that its findings cannot automatically be applied to the foods selected for the present study.

**3 Prior et al. (2005): Methods for Measuring Antioxidant Capacity**
Prior et al. (2005) reviewed methods for determining antioxidant capacity and phenolic content in foods and dietary supplements. The authors discussed the chemical principles underlying different assays, the types of reactions they measure, and the advantages and limitations associated with their application. Their review highlighted the importance of using appropriate methods and interpreting results according to the particular antioxidant mechanisms measured. Different assays may produce different estimates because they respond differently to the compounds present in a sample. This work provides a methodological foundation for the present study. It supports the use of validated procedures and careful interpretation when comparing antioxidant properties among indigenous food samples.

**4 Munteanu and Apetrei (2021): Analytical Methods for Antioxidant Activity**
Munteanu and Apetrei (2021) reviewed analytical methods used to determine antioxidant activity, including DPPH, ABTS, FRAP, and other chemical assays. Their review described the principles of the different methods and highlighted the fact that antioxidant activity can be evaluated through distinct reaction mechanisms. The review is relevant because it demonstrates that no single chemical assay captures every aspect of antioxidant behaviour. The selection of an analytical method should therefore reflect the research objective, the sample characteristics, and the limitations of the test. For the present study, this evidence supports selecting suitable antioxidant assays and reporting their results separately, with consistent units and analytical conditions.

**Research Gap**
Existing studies have evaluated the nutritional composition and antioxidant properties of indigenous Nigerian beverages, vegetables, spices, soups and cereal grains. These investigations provide useful evidence that traditional foods can contain important nutrients and compounds with measurable antioxidant activity. However, the available studies differ in the types of foods investigated, the geographical locations from which samples were obtained, and the laboratory methods used. Findings from southern Nigeria, for example, cannot automatically be assumed to represent indigenous foods obtained from Bauchi State.
The 2025 study by Mode et al. examined millet varieties from northern Nigeria, while other studies focused on indigenous spices, vegetables or prepared foods. These studies provide relevant background but do not, by themselves, establish the comparative nutritional composition and antioxidant properties of the specific foods selected for the present research in Bauchi State.
The research gap addressed by this study is therefore the need for a systematic comparison of selected indigenous foods obtained from Bauchi State using consistent analytical procedures. By determining their proximate composition and selected antioxidant parameters under comparable conditions, the study can generate local evidence on differences in nutritional quality and antioxidant potential. The extent of this gap should be confirmed through a broader search of

journal articles, university repositories and Nigerian postgraduate research databases before making an absolute claim that no previous study has investigated the subject in Bauchi State.

**Research Methodology**

The study employed a laboratory-based experimental design to evaluate the nutritional composition and antioxidant properties of selected indigenous foods obtained from Bauchi State, Nigeria. The food samples were collected, cleaned, prepared and analysed using standard laboratory procedures. Proximate analysis was conducted to determine moisture, crude protein, fat, fibre, ash and carbohydrate contents. Antioxidant properties were assessed using appropriate methods, such as DPPH radical-scavenging activity, FRAP and total phenolic content. The results were analysed statistically to compare the food samples, with differences considered significant at $p<0.05p < 0.05$. Findings were presented in tables and discussed in relation to existing scientific literature.

**Discussion of Results**

The discussion of results for the research topic, "Comparative Evaluation of the Nutritional Composition and Antioxidant Properties of Selected Indigenous Foods in Bauchi State, Nigeria," focuses on interpreting the nutritional composition and antioxidant activities of the selected food samples in relation to previous scientific studies.

**1 Nutritional Composition**

The results of the proximate analysis are used to evaluate the nutritional quality of the selected indigenous foods. Differences in moisture, crude protein, fat, fibre, ash and carbohydrate contents may be attributed to variations in food type, variety, growing conditions and processing methods. Moisture content influences food stability and shelf life, while protein contributes to growth and tissue repair. Fat provides energy, and fibre supports normal digestive function. Ash content provides an estimate of total inorganic residue, while carbohydrate represents an important source of dietary energy. Foods with higher protein, fibre or mineral contents may contribute particular nutrients to the diet. However, the nutritional importance of each food depends on its overall composition, serving size and nutrient availability.

**2 Antioxidant Properties**

Differences in antioxidant activity among the food samples may be associated with variations in phenolic compounds, flavonoids, vitamins and other bioactive substances. Samples with higher DPPH radical-scavenging activity or FRAP values demonstrate greater activity under the specific laboratory conditions used.

Total phenolic content may help explain differences in antioxidant activity, although a higher phenolic concentration does not always correspond to stronger activity in every assay. Extraction procedures, sample preparation and the chemical characteristics of individual compounds may influence the results.

**3 Comparison with Previous Studies**

The findings should be compared with previous research on indigenous Nigerian foods. For example, Ajiboye et al. (2014) investigated the nutritional and antioxidant properties of traditional sorghum- and millet-based beverages, while Ene-Obong et al. (2018) studied the chemical composition and antioxidant activities of indigenous Nigerian spices.

Similarities between the present findings and these studies may indicate common nutritional characteristics among certain traditional foods. Differences may result from variations in food species, geographical origin, processing conditions, analytical methods and sample preparation.

**4 Nutritional and Practical Implications**

The findings may provide useful information about the nutritional value and antioxidant potential of indigenous foods consumed in Bauchi State. Such information can support food composition research, dietary planning and the preservation of traditional food resources.

Nevertheless, laboratory antioxidant activity alone does not establish the health effects of consuming a food. Further research may be required to investigate nutrient bioavailability and biological effects.

**5 Conclusion of the Discussion**

Overall, comparing nutritional composition and antioxidant properties can provide a broader understanding of the characteristics of indigenous foods. The interpretation of the study should identify which samples recorded the highest and lowest values for each parameter and explain these differences using relevant scientific evidence.

**Summary of Findings**

The study examined the nutritional composition and antioxidant properties of selected indigenous foods in Bauchi State, Nigeria. The nutritional composition was evaluated through proximate analysis, including moisture, crude protein, crude fat, crude fibre, ash and carbohydrate contents. The antioxidant properties were assessed using appropriate laboratory methods, such as DPPH radical-scavenging activity, ferric reducing antioxidant power (FRAP) and total phenolic content. The study was designed to identify differences in the nutritional composition and antioxidant properties of the selected foods. The findings are intended to provide information on their nutritional value and potential contribution to dietary quality.

However, the specific food samples and laboratory results were not provided; therefore, the foods with the highest or lowest nutritional and antioxidant values cannot be identified here.

**Conclusion**

The comparative evaluation of the nutritional composition and antioxidant properties of indigenous foods is important for understanding their potential contribution to human nutrition. Indigenous foods may provide essential nutrients and naturally occurring bioactive compounds that contribute to dietary quality.

The study provides a framework for assessing differences among selected indigenous foods consumed in Bauchi State. The actual conclusions regarding their relative nutritional quality and antioxidant capacity should be based on the laboratory results obtained. These results can help identify foods that may be valuable sources of particular nutrients and antioxidant-active compounds.

**Recommendations**

Based on the objectives of the study, the following recommendations are proposed:

1. Promotion of indigenous foods: Consumers should be encouraged to include a variety of nutritious indigenous foods in their diets as part of a balanced dietary pattern.

2. Nutritional awareness: Nutrition education programmes should provide information about the nutritional composition and appropriate preparation of locally available foods.
3. Improved processing and storage: Appropriate processing, handling and storage practices should be encouraged to minimise nutrient losses and maintain food quality.
4. Further research: Additional studies should investigate the nutritional composition, phytochemical content and antioxidant properties of a wider range of indigenous foods in Bauchi State.
5. Standardised laboratory analysis: Future investigations should use validated analytical methods, appropriate controls and replicate measurements to improve the reliability and comparability of results.
6. Further investigation of health effects: Studies should examine nutrient bioavailability and, where appropriate, biological effects rather than assuming that antioxidant activity measured in vitro directly establishes health benefits in humans.
7. Support for local food resources: Relevant agricultural, food science and public health institutions should support research, documentation and sustainable utilisation of indigenous food resources.

**Contribution to Knowledge**

The study is intended to contribute to knowledge by providing comparative information on the nutritional composition and antioxidant properties of selected indigenous foods in Bauchi State, Nigeria. Such information may support future food composition studies, nutritional assessment and the preservation of local food resources.

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