Proximate and Amino Acid Compositions of Commonly Consumed Native Soups among Nupe People of Niger State, Nigeria

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ABSTRACT

Background: *Soups usually accompany major Nigerian staple foods (swallow) and it is very essential to Nigerian food recipes.*

Objective: *This study aims at evaluating the proximate and amino acid compositions of commonly consumed native soups among Nupe people of Niger state, Nigeria.*

Methods: *A cross sectional survey was conducted to document the commonly consumed native soups among Nupe people residing in Bida and Lavun Local Government Areas of Niger state using stratified sampling method. The ingredients for the recipes of six (6) commonly consumed soups were standardized in the laboratory, prepared and evaluated for some nutrient contents using standard procedures for proximate and amino acids analyses.*

Results: *The result shows that ash content of the soups ranged from 1.90±0.37 to 3.46±0.61 g/100g, crude fat content was from 8.17±0.28 to 16.49±1.95 g/100g, and the protein contents was between 4.43±0.59 to 7.81±1.23 g/100g. The carbohydrate ranged from 1.5±0.80 – 15.30±2.58 g/100g and the estimated energy value for the soups was between 109.35±2.21 – 188.97±14.74 kcal. Level of leucine ranged from 6.05±0.19 – 8.01±0.09 g/100g, lysine (3.44±0.06 – 7.05±0.06 g/100g), isoleucine (3.60±0.08 – 4.37±0.04 g/100g), and threonine ranged from 3.03±0.11 to 3.90±0.03 g/100g.*

Conclusion: *The consumption of these soups could help contribute to daily nutrient intake and prevent protein deficiency related diseases in the people.*

Keywords: Amino Acids, Native Soup, Nutrient, Vegetable and Protein

INTRODUCTION

Traditional foods are an important part of the culture, history, identity and heritage of a region or country hence are key elements in dietary pattern [1]. The diets of the people are based on the foods produced and marketed in the different zones. Evidence abound showing that knowledge of the traditional food base is being eroded as urbanization has created changes in food consumption patterns with more processed foods being available in cities [1]. Thus result in the use of fewer species and decreased dietary diversity due to household food insecurity which leads to poor health status. Research indicates that consumers have shown increased interest in the

demand for traditional foods, as these foods have certain sensory characteristics and higher quality [2].

Nigeria is multi-cultural society with different traditional soups which are indigenous to the different ethnic and cultural society [3]. Soup is primarily a liquid food, generally served warm, hot or cold and it is made by combining ingredients such as meat and vegetables with stock, juice, or water [4]. Traditionally, soups are classified into two main groups; clear soups and thick soups [4]. Clear soups are mainly prepared from the use of clear extracts of edible animal or plant parts while cereal or pulse flour, starch cream or eggs for the thick soup [5]. Soups are similar to stews and in some cases there may not be a clear distinction between the two, however soups generally are more liquids than stews [4]. Soups usually accompany the major Nigerian staple foods (swallow) and rely on the richness of the soups to make the meal delicious. It is common that Nigerians especially from the Northern region of the country must have at least one swallow meal per day. This is why soups are very essential to Nigerian food recipes. The various swallow meals eaten in Nupe land with the soups may include "tuwo shinkafa" with "eni ezowa" (rice flour meal plus beans soup), "tuwo masara" and "eni kpanmi" (maize flour meal and okra soup), "tuwo dawa" with "eni kuka" (sorghum flour meal with kuka soup) and pounded yam.

Vegetables are important ingredients in any Nupe people soups and Nigerian soups in general. The vegetables are valuable sources of nutrients, as they contribute substantially to protein, mineral, vitamins, fibre and other nutrients which are usually in short supply in most daily diets [6]. Proteins are group of large complex molecules that serve as structural components and regulate a large variety of bodily functions [7]. The constituents of proteins are amino acids; there are 20 naturally occurring amino acids, which can be assembled in various combinations and numbers to make the thousands of different types of proteins. The main functions of proteins are growth and replacement of lost tissues in the body.

There is need for all Nigerians to know the nutrient composition of their local soups, which are usually neglected in meal planning due to lack of information on their nutrient composition and as such, protein energy malnutrition (PEM) and micronutrient deficiencies results. Some of these soups are rich in protein, calorie, vitamin and other components and as such there is need for the diversification and adequate consumption of the traditional foods and their products to combat protein energy malnutrition and micronutrient deficiencies [8]. The knowledge of the nutritional composition of traditional soups will ease therapeutic meal planning and service. This study therefore evaluates the proximate and amino acid compositions of commonly consumed native soups among the Nupe people of Niger state, Nigeria.

Materials and Methods

Study Area

The study areas are Bida and Lavun LGAs of Niger state, Nigeria. Bida is located on geographical coordinates: 9° 05′ N 6° 01′ E, with an area of 50sq km and a projected population of 260,700 as at 2016. Bida is the ancient city of Nupe kingdom in Nigeria and known for production of traditional crafts, notably glass, bronze, art crafts and brass wares. Lavun LGA has its headquarters in Kutigi town located in the southern area of Niger state at 9° 12′ 00″ N 5° 36′ 00″ E. The Kaduna River is at the eastern border of the LGA, with an area of 2,835sq km and a projected population of 294,700 as at the 2016..

Nupe-speaking people live near the Confluence Rivers of Niger and Kaduna State of Nigeria. There are about 4.5 million Nupe people, with the largest population found in Bida [9]. Nupe land is made up of an agrarian population; their economy and social life revolve round agriculture and the people are active farmers. Those living in the riverine areas are mostly fishermen and their wives actively engaged in processing and selling of fish. Major agricultural produces in Nupe land

are rice, sorghum, millet, sugarcane, melon, groundnut, vegetables, yam and melon.

Study Design

A cross sectional survey was carried out in order to document the commonly consumed native soups by Nupe people while standardization of the soup recipes was done by identifying and weighing all the ingredients, with nutrient analysis carried out in the laboratory.

Sampling Technique

Stratified sampling technique was used in which the South senatorial district where most of the Nupe people reside in the state was stratified into North and South and one local government was picked from each stratum. Bida and Lavun LGAs were randomly selected, then clustered into wards from which, seven (7) wards were randomly selected from the two (2) LGAs for the survey. Bida LGA has 14 wards from which four (4) wards were randomly selected whereas Lavun with 11 wards from which three (3) wards were also selected to give a total of seven (7) wards selected from the two (2) LGAs. Based on the responses received after the administration of the survey questionnaire, the most commonly consumed soups were selected for standardization and then prepared in the laboratory.

Sample Collection

All the major soup ingredients used were bought from Estu Musa market in Bida town of Niger state.

Standardized Soup

All the ingredients used for the soups recipe were standardized by weighing the items on a balance (ScoutPro, Ohaus) and water was measured using graduated cup. The weight of the empty pot used was determined using weighing scale (CAMRY Emperor, China) and the yield was by weighing the pot and its contents on the weighing scale.

The recipes collected were standardized using modified National Food Service Management Institution (NFSMI) method [10], which includes three phases: recipe verification, product evaluation and quantity adjustment. In this study, the two major stages of recipe verification phase (recipe review and recipe preparation), was carried out. This was carried out on one recipe at a time to find out if the recipe contained the following information: (a) recipe title, (b) recipe category, (c) ingredients, (d) weight/volume for each ingredient, (e) preparation instructions (directions), (f) cooking temperature and time, if appropriate, (g) Serving size, (h) recipe yield, (i) equipment and utensils used.

Methods of Soup Preparation

"Eni Kuka" (Kuka soup)

A pre-weighed aluminum pot was put on a stove to allow the pot to dry. Then 50g of palm oil was added and allowed to fry for 2 minutes. Exactly 14g of fresh pounded pepper with 20g of onion was added to the oil, then 15g of "kula tsaka" (Locust bean), maggi (12g), and salt (3g) were added. Exactly 500ml of water was added to the contents in the pot and boiled for 10 minutes, after which 50g of dried fish was added and further heated for another 5 minutes. The fish was removed and then 50g of "kuka" powder was added slowly with constant smoothening with

List of Soups Prepared

Common Name	Scientific Name	Nupe Name
Kuka (Baobab powder leaves)	*Adansonia digitate*	Eni kuka
Okra (Dry)	*Abelmoschus esculentus*	Eni Tsuku
Okra (Fresh)	*Abelmoschus esculentus*	Eni Kpanmi
Beans soup	*Vigna ungucuilata*	Eni Ezowa
Fresh Sorrel calyx	*Hibiscus sabdariffa*	Eni Emagi
African custard apple calyx	*Annona senegalensis*	Eni Nungbere

cooking broom. Additional 200ml of water was further added to the soup, the fish was returned to the pot and heated for another 5 minutes. The pot was brought down from the stove, cooled; the pot and its contents were weighed to determine the yield. None of the optional ingredients were used in this soup preparation (Table 1).

Table 1: Ingredients Used for Kuka Soup (Eni Kuka)

English Name	Nupe Name	Weight/ Volume used	Local Measurement	Variation in Quantity	Optional Ingredient
Baobab leaves Powder	Kuka	50g	1 small tin cup of milk	25 – 75g	
Dry fish without bone or head	Ikan	50g	2 medium size	40 – 60g	Meat or Fresh fish
Palm Oil	Emi dzuru	50g	1 small tin cup of tomato	25 – 75g	Groundnut oil
Pepper (Fresh)	Rudu	14g	4 pieces	10 – 18g	Dry grounded pepper
Onion	Lubasa	20g	1 small size bulb	10 – 30g	
Maggi star	Maggi	12g	3 cubes	6 – 18g	Royco cubes
Locust beans	Kula tsaka	15g	4 pieces	10 – 20g	
Salt	Esan	3g	½ teaspoon	2 – 4g	
Water	Nuwa	700ml	2 small cup	500 – 900ml	
Average Yield		638.33g			

"Eni Tsuku" (Okra soup, Powder)

A pre-weighed aluminum pot was put on a stove to allow the pot to dry. Then 50g of palm oil was added and allowed to fry for 2 minutes. Exactly 14g of fresh pounded pepper with 20g of onion was added to the oil, then 15g of "kula tsaka" (Locust bean), maggi (12g), and salt (3g) were added. Exactly 500ml of water was added to the contents in the pot and boiled for 10 minutes, after which 50g of dried fish was added and further heated for another 5 minutes. The fish was removed and then 50g of dried okra powder was added slowly with constant smoothening with cooking broom. Additional 150ml of water was further added to the soup, the fish was returned to the pot and heated for another 5 minutes. The pot was brought down, cooled; the pot and its contents were weighed to determine the yield. None of the optional ingredients were used in this soup preparation (Table 2).

Table 2: Ingredients Used for Okra Soup (Powder) (Eni Tsuku)

English Name	Nupe Name	Weight/ Volume Used	Local Measurement	Variation in Quantity	Optional Ingredient
Okra Powder	Tsuku	50g	1 small tin cup of milk	25 – 75g	
Dry fish without bone or head	Ikan	50g	2 medium size	40 – 60g	Meat or Fresh fish
Palm Oil	Emi dzuru	50g	1 small tin cup of tomato	25 – 75g	Groundnut oil
Pepper (Fresh)	Rudu	14g	4 pieces	10 – 18g	Dry grounded pepper
Onion	Lubasa	20g	1 small size bulb	10 – 30g	
Maggi star	Maggi	12g	3 cubes	6 – 18g	Knorr cubes
Locust beans	Kula tsaka	15g	4 pieces	10 – 20g	
Salt	Esan	3g	½ teaspoon	2 – 4g	
Water	Nuwa	650ml	2 small cup	600 – 700ml	
Average Yield		650.00g			

"Eni Kpanmi" (Fresh Okra soup)

A pre-weighed aluminum pot was kept on a stove to allow the pot to dry and then 25g of palm oil was added and allowed to fry for 2 minutes. Exactly 14g of fresh pounded pepper was added to the oil, then 15g of "kula tsaka" (Locust bean), maggi (12g), and salt (3g) were added. Exactly 250 ml of water and 1.4g potash were added to the contents in the pot and boiled for 7 minutes. Then 100g of fresh sliced okra was added and 50g of dried fish was also added and further heated for another 5 minutes. Additional 100 ml of water was further added to the soup and heated for another 3 minutes. The pot was put down, cooled; the pot and its contents were weighed to determine the yield. None of the optional ingredients were used in this soup preparation (Table 3).

Table 3: Ingredients Used for Fresh Okra Soup (Eni Kpanmi)

English Name	Nupe Name	Weight/ Volume Used	Local Measurement	Variation in Quantity	Optional Ingredient
Fresh Okra	Kpanmi	100g	30 pieces	50 – 150g	
Dry fish without bone or head	Ikan	50g	2 medium size	40 – 60g	Meat or Fresh fish
Palm Oil	Emi dzuru	25g	½ small tin cup of tomato	25 – 75g	
Pepper (Fresh)	Rudu	14g	4 pieces	10 – 18g	Dry grounded pepper
Potash	Kanwa	1.4g	4 small pieces	10 – 30g	May not be use
Maggi star	Maggi	12g	3 cubes	6 – 18g	Royco cubes
Locust beans	Kula tsaka	15g	4 pieces	10 – 20g	
Salt	Esan	3g	½ teaspoon	2 – 4g	
Water	Nuwa	350ml	1 small cup	300 – 400ml	
Average Yield		466.67g			

"Eni Nungbere" (Custard Apple Calyx soup)
A pre-weighed aluminum pot was put on a stove to allow the pot to dry. Then 100g of palm oil was added and allowed to fry for 2 minutes. Exactly 14g of fresh pounded pepper with 20g of onion was added to the oil, then 15g of "kula tsaka" (Locust bean), maggi (12g), and salt (3g) were added. Exactly 400ml of water was added to the contents in the pot and heated for 10 minutes, after which 50g of fish was added and further boiled for another 5 minutes. The fish was removed and then 50g of "Nungbere" powder was added slowly with constant smoothening with cooking broom. Additional 250ml of water was further added to the soup, the fish was returned and boiled for another 5 minutes. The pot was brought down from the stove, cooled; the pot and its contents weighed were weighed to determine the yield. The optional ingredients were not used in the preparation of this soup (Table 4).

Table 4: Ingredients for Nungbere Soup (Eni Nungbere)

English Name	Nupe Name	Weight/ Volume Used	Local Measurement	Variation in Quantity	Optional Ingredient
Nungbere Powder	Nungbere	50g	1 small tin cup of milk	25 – 75g	
Dry fish without bone or head	Ikan	50g	2 medium size	40 – 60g	Meat or Fresh fish
Palm Oil	Emi dzuru	100g	2 small tin cup of tomato	75 - 125g	
Pepper (Fresh)	Rudu	14g	4 pieces	10 – 18g	Dry grounded pepper
Onion	Lubasa	20g	1 small size bulb	10 – 30g	
Maggi star	Maaggi	12g	3 cubes	6 – 18g	Knorr cubes
Locust beans	Kula tsaka	15g	4 pieces	10 – 20g	
Salt	Esan	3g	½ teaspoon	2 – 4g	
Water	Nuwa	650ml	2 small cup	600–700ml	
Average Yield		733.33g			

"Eni Emagi" (Roselle/Sorrel Calyx soup)
A pre-weighed aluminum pot was put on a stove to allow the pot to dry and then 50g of palm oil was added and allowed to fry for 2 minutes. Accurately 14g of fresh pounded pepper with 20g of onion was added to the oil, and then 15g of "kula tsaka" (Locust bean), maggi (12g), salt (3g) and 25g of grounded melon were added. Exactly 500ml of water was added to the contents in the pot and boiled for 10 minutes, after which 50g of dried fish was added and further heated for another 5 minutes. Exactly 160g "emagi" (green sorrel calyx) was added to the contents and additional 150 ml of water was further added to the soup and heated for another 5 minutes. The pot was put down, cooled; the pot and its contents were weighed to determine the yield. The optional ingredients were not used for this soup preparation (Table 5).

Table 5: Ingredients for Green Calyx Roselle (Eni Emagi)

English Name	Nupe Name	Weight/ Volume Used	Local Measurement	Variation in Quantity	Optional Ingredient
Green Calyx Roselle	Emagi	160g	½ mudu	100 – 220g	
Dry fish without bone or head	Ikan	50g	2 medium size	40 – 60g	Meat or Fresh fish
Palm Oil	Emi dzuru	50g	1 small tin cup of tomato	25 - 75g	Groundnut Oil
Pepper (Fresh)	Rudu	14g	4 pieces	10 – 18g	Dry grounded pepper
Onion	Lubasa	20g	1 small bulb	10 – 30g	
Maggi star	Maaggi	12g	3 cubes	6 – 18g	Royco cubes
Locust beans	Kula tsaka	15g	4 pieces	10 – 20g	
Melon (Grounded)	Egusi	25g	2 spoonful	15 – 35g	Melon may not be use
Salt	Esan	3g	½ teaspoon	2 – 4g	
Water	Nuwa	650ml	2 small cup	600–700ml	
Average Yield		850.00g			

"Eni Ezowa" (Beans soup)

A pre-weighed aluminum pot was kept on a kerosene stove and exactly 500ml of water was added to the pot. Then 148g of uncoated bean seeds with 2g of potash was added to the pot. The contents were allowed to boil for 30 minutes after which, the bean seeds was smoothening with cooking broom. Then 14g of fresh pounded pepper with 20g of onion, palm oil (50g) were added and boiled for further 10 minutes. Exactly 15g of "kula tsaka" (Locust bean), maggi (12g), salt (3g) and 50g of dried fish were added and allowed to heat for another 15 minutes. Additional 85ml of water was added and the contents were allowed to boil for another 5 minutes. The pot was brought down, cooled; the pot and its contents were weighed to determine the yield. None of the optional ingredients were used in this soup preparation (Table 6).

Sample Preparation

The prepared standardized soups were homogenized with the use of laboratory blender (Waring commercial HGBTWTS3). Five grams of each sample was used to determine the actual moisture at 100°C, while the rest sample was dried at 60°C in an oven drier (DHG 9202, Drying oven). Then packaged in an air-tight container and stored in the freezer at 4°C until ready for nutrient analysis.

Nutrient Analysis

Proximate Analysis

Proximate analysis was carried out according to AOAC methods [11] to determine moisture, crude fats, ash, crude protein, crude fibre and total carbohydrate.

Table 6: Ingredients Used for Beans Soup (Eni Ezowa)

English Name	Nupe Name	Weight/ Volume Used	Local Measurement	Variation in Quantity	Optional Ingredient
Bean seeds	Ezowa	148g	1 small tin cup of milk	100 – 196g	
Dry fish without bone or head	Ikan	50g	2 medium size	40 – 60g	Meat or Fresh fish
Palm Oil	Emi dzuru	50g	1 small tin cup of tomato	25 - 75g	
Pepper (Fresh)	Rudu	14g	4 pieces	10 – 18g	Dry grounded pepper
Onion	Lubasa	20g	1 small bulb	10 – 30g	
Maggi star	Maaggi	12g	3 cubes	6 – 18g	Knorr cubes
Locust beans	Kula tsaka	15g	4 pieces	10 – 20g	
Salt	Esan	3g	½ teaspoon	2 – 4g	
Water	Nuwa	585ml	1 ½ small cup	550–620ml	
Average Yield		766.67g			

Determination of Moisture Contents

A glass petri-dish was accurately weighed, after which 5.0g of the sample was added and reweighed and the weight recorded as (W1). This was kept in a drying oven for 4 hours at 100°C to determine the actual moisture of the standardized soups. The dish was removed from the oven, cooled in a desiccator and re-weighed and recorded as (W2). This process was repeated until a constant weight was attained. This process was repeated for all the samples, and the moisture content was calculated in percentage as follows:

$$\% \text{ Moisture} = \frac{W1 - W2 \times 100}{\text{Weight of sample used}}$$

Determination of Ash Content

Accurately 2.0g of the sample was weighed into a platinum crucible and recorded as W1. This was transferred to muffle furnace (SXL-1008) at the temperature of 550°C for 5 hours or until a white ash was obtained. The platinum crucible was removed and place in a desiccator to cool and weighed, this was recorded as W2.

Calculation:

$$\% \text{ Ash} = \frac{W1 - W2 \times 100}{\text{Weight of sample used}}$$

Determination of Crude Fibre

Exactly 2.0g of the soup sample was digested in 200ml of 1.25% H_2SO_4, the mixture was boiled for 30min on heating mantle, filtered and washed with hot water to reduce the acidity, and this was tested with pH paper indicator. The residue was again transferred and digested in 200ml of 1.25% NaOH. The mixture was heated for 30min, filtered using buncher funnel under pressure and washed with hot water. The filter paper and its content was placed in a drying oven, this was then transferred to a platinum crucible and weighed (W1). The crucible was heated in a muffle furnace at 550^{0}C to ash and weighed again as W2.

Percentage crude fibre was calculated as:

$$\% \text{ Crude fibre} = \frac{W1 - W2 \times 100}{\text{Weight of sample used}}$$

Determination of Crude Fat

Two gramme (2.0g) of the sample was weighed and placed in a filter paper. The filter paper and its content were transferred into a soxhlet apparatus extractor. The flask was filled with 300ml petroleum ether (40-60°C) and allowed to boil. The soxhlet apparatus was allowed to reflux for about 4 hours. The filter paper was removed and the petroleum ether was recovered for re-use. The flask was heated in the oven at 80°C until the solvent was completely evaporated. The dried flask was then transferred to a desiccator to cool and weighed.

Calculation:

$$\% \text{ Crude fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100$$

Determination of Crude Protein

Exactly 0.5g of dried samples was weighed into digestion flask, 20ml of concentrated H_2SO_4 and 5g of kjehdal catalyst ($CuSO_4$, K_2SO_4 and Selenium dioxide) were added. This was heated on a digestion heater until a clear solution was obtained. The ammonia involved was steam distilled into 4% boric acid solution; the nitrogen from ammonia was deduced from the titration of the trapped ammonia with 0.1N HCl, methyl red and bromocresol green indicator until a green colouration was observed, which indicate the end point of titration. Protein was calculated by multiplying the deduced value of nitrogen with protein conversion factor 6.25.

Percentage Nitrogen

$$= \frac{(a-b) \times 0.01 \times 14 \times V \times 100}{W \times C}$$

Where:

a. = Titre value of the digested sample
b. = Titre value of blank sample
v. = Volume after dilution (100ml)
W. = Weight of dried sample (mg)
C. = Aliquot of the sample used (5ml)
14. = Nitrogen constant in mg.

Determination of Total Carbohydrate

The total carbohydrate content of the soups was calculated by difference.

Total carbohydrate = 100 - (protein + ash + crude fat+ crude fibre + moisture).

Water Conversion Factor (WCF)

Water Conversion Factor (WCF) method was used for the soup samples as described by Davidson *et al.*, [12].

$$WCF = \frac{100 - \text{Actual moisture}}{100 - \text{Residual moisture}}$$

The values obtained through chemical analysis were multiplied with the WCF to obtain nutrient contents of the recipes as consumed.

Energy Consumed

Energy value of the soup samples were calculated by multiplying crude fat with 9 kcal/37 KJ, carbohydrate with 4 kcal/17 KJ and crude protein contents with 4 kcal/17 KJ and sum up all the values using Atwater's Conversion factor [13].

Amino Acids Profile

Amino acids content of the sample was determined using methods described by Benitez [14]. Exactly 2g of sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator (RE52-3) and loaded into the Applied Biosystems PTH Amino Acid Analyzer (120A PTH).

Defatting Sample

The sample was defatted using chloroform/methanol mixture of ratio 2:1. The sample (2.0g) was put in extraction thimble and extracted for 5 hours in soxhlet extraction apparatus [15].

Nitrogen Determination

Exactly 150mg of ground sample was weighed, wrapped in whatman filter paper (No.1) and put in the Kjeldahl digestion flask and 10ml of concentrated sulphuric acid was added. Catalyst mixture (0.5g) containing sodium sulphate (Na_2SO_4), copper sulphate ($CuSO_4$) and selenium oxide (SeO_2) in the ratio of 10:5:1 was added into the flask to facilitate digestions with six (6) pieces of anti-bumping granules were added. The flask was then put in Kjeldahl digestion apparatus and digested for 3 hours until the liquid turned light green. The digested sample was cooled and diluted with distilled water to 100ml in standard volumetric flask. Aliquot (10m1) of the diluted solution with 10ml of 45% sodium hydroxide was put into the Markham distillation apparatus and distilled into 10ml of 2% boric acid containing 4 drops of bromocresol green/methyl red indicator until about 70ml of distillate was collected. The distillate was then titrated with standardized 0.01N hydrochloric acid to grey coloured end point.

$$\text{Percentage Nitrogen} = \frac{(a-b) \times 0.01 \times 14 \times V \times 100}{W \times C}$$

Where:

a. = Titre value of the digested sample

b. = Titre value of blank sample

v. = Volume after dilution (100ml)

W. = Weight of dried sample (mg)

C. = Aliquot of the sample used (5ml)

14. = Nitrogen constant in mg.

Hydrolysis of the Sample

Exactly 0.1885g of the defatted sample was weighed into glass ampoule. Then 7ml of 6N HCl was added and oxygen was expelled by passing nitrogen into the ampoule (this is to avoid possible oxidation of some amino acids during hydrolysis e.g methionine and cystine). The glass ampoule was then sealed with bunsen burner flame and put in an oven preset at 105°C ±5°C for 22 hours. The ampoule was allowed to cool before broken open at the tip and the content was filtered to remove the humins. It should be noted that tryptophan is destroyed by 6N HCL during hydrolysis. The filtrate was then evaporated to dryness using rotary evaporator. The residue was dissolved with 5ml to acetate buffer (pH 2.0) and stored in plastic specimen bottles, which were kept in the freezer.

Loading of the Hydrolysate into Analyzer
The amount loaded was 60 microlitres and dispensed into the cartridge of the analyzer to separate and analyze free acidic, neutral and basic amino acids of the hydrolysate.

Method of Calculating Amino Acid Values
An integrator attached to the Analyzer calculates the peak area proportional to the concentration of each of the amino acids.

g/100g Protein = g/16gN

Statistical Analysis
The data obtained were subjected to ANOVA using IBM SPSS statistics 23 package. Means were separated using Duncan's Multiple Range Test (DMRT). Significance was accepted at $p < 0.05$. Values are given as Mean ± S.D.

Results
The results of the proximate and amino acid compositions of the commonly consumed native soups among Nupe people are presented in the tables.

Table 7 shows the result of proximate composition of the commonly consumed native soups among Nupe people of Niger state. Moisture content ranged from 66.60 to 82.60 g/100g. "Eni emagi" had the highest moisture content (82.60 g/100g) while the least was in "Eni Ezowa" (66.60 g/100g). "Eni kuka" had the highest ash contents (3.46 g/100g) and the lowest was in "Eni Emagi" (1.90 g/100g). The ash contents in "Eni kuka" and "Eni emagi are significantly different ($p<0.05$) compared to the other soup samples. Crude fat content indicates highest value (16.49 g/100g) for "Eni nungbere, followed by "Eni kuka" (13.25 g/100g) and "Eni Kpanmi" (8.17 g/100g) had the least. There was significant difference ($p<0.05$) in the crude fat contents of "Eni kuka" and "Eni Nungbere", each of which are significantly different ($p<0.05$) from the other soups. The crude fibre of the soups was between 0.01 to 0.09 g/100g, with both "Eni Kpanmi" and "Eni Emagi" recording the lowest content whereas "Eni Tsuku" had the highest concentration. "Eni Tsuku" crude fibre content was significantly different ($p<0.05$) from the other soups except "Eni Nungbere". The mean value for the crude protein ranged from 4.43 g/100g in "Eni Emagi" to 7.81 g/100g in "Eni kuka". Mean value for crude protein are not significantly different ($p>0.05$). Total carbohydrate content for the standardized soups was found to be 15.30 g/100g in "Eni Ezowa" as the highest mean while the lowest value was in "Eni Emagi" (1.58 g/100g), and "Eni Ezowa" value was significantly different ($p<0.05$) from the other soups. The energy contents of the soups ranged from 109.35 kcal in "Eni Emagi" to 188.97 kcal in "Eni Nungbere". The energy content of "Eni Nungbere" was significantly different ($p<0.05$) from the other soups.

Table 7: Proximate Composition of Commonly Consumed Native Soups among Nupe People of Niger State (g/100g dry weight)

Soups	Moisture Content	Ash Content	Crude fat	Crude Fibre	Crude Protein	Total Carbohydrate	Energy (kcal)
"Eni Kuka"	73.33±1.96^{b}	3.46±0.61^{d}	13.26±2.50^{b}	0.03±0.01^{a}	7.81±1.23^{a}	2.11±1.80^{a}	159.04±17.79^{b}
"Eni Tsuku"	76.67±1.92^{c}	3.10±0.23^{cd}	9.07±1.80^{a}	0.09±0.05^{b}	6.28±0.40^{a}	4.79±1.83^{a}	125.92±12.15^{a}
"Eni Kpanmi"	79.13±0.76^{d}	3.31±0.20^{cd}	8.17±0.28^{a}	0.01±0.00^{a}	5.31±3.19^{a}	4.07±4.08^{a}	111.04±2.83^{a}
"Eni Nungbere"	71.13±1.36^{b}	2.19±0.85^{ab}	16.49±1.95^{c}	0.05±0.02^{ab}	5.32±0.46^{a}	4.83±0.94^{a}	188.97±14.74^{c}
"Eni Emagi"	82.60±0.35^{e}	1.90±0.37^{a}	9.48±0.38^{a}	0.01±0.00^{a}	4.43±0.59^{a}	1.58±0.80^{a}	109.35±2.21^{a}
"Eni Ezowa"	66.60±0.53^{a}	2.68±0.44^{bc}	8.46±0.41^{a}	0.04±0.02^{a}	6.92±2.91^{a}	15.30±2.58^{b}	165.02±1.62^{b}

Values are Mean± S.D of triplicate determinations. Values with different superscripts down the column are significantly different ($p<0.05$).

Table 8 shows the essential amino acid compositions of native soups consumed among Nupe people of Niger state. Concentration of luecine in the standardized soups revealed that "Eni nungbere" had the highest concentration (8.01±0.09 g/100g crude protein), followed by "Eni emagi" (7.47±0.15 g/100g c.p) and the least was in "Eni kuka" (6.05±0.19 g/100g c.p). Lysine concentration in soup indicates that "Eni kpanmi" (7.05±0.06 g/100g c.p) had the highest concentration while the least was in "Eni kuka" (3.44±0.06 g/100g c.p). The result also shows that the concentration of isoleucine contents ranged from 3.60±0.08 to 4.37±0.08 g/100g c.p. "Eni kuka" (3.60±0.08 g/100g c.p) had the least concentration and "Eni nungbere" (4.37±0.08 g/100g c.p) was found to have the highest concentration. Isoleucine concentration in "Eni nungbere" was significantly different ($p<0.05$) from other soups. Phenylalanine contents for "Eni ezowa" (5.03±0.09 g/100g c.p) was found to be highest whereas "Eni emagi" (3.84±0.27 g/100g c.p) had the least concentration. Tryptophan concentration of the soups show that "Eni nungbere" (1.17±0.08 g/100g c.p.) had the highest concentration, followed by "Eni emagi" (1.01±0.08 g/100g c.p) and lowest concentration was in "Eni kuka" (0.87±0.03 g/100g c.p). The concentration of tryptophan in "Eni nungbere" and "Eni emagi" are significantly different ($p<0.05$) from the other soups. Valine contents in the standardized native soups ranged from 3.62±0.06 to 4.33±0.12 g/100g c.p, with "Eni ezowa" (3.62±0.06 g/100g c.p) recording the lowest concentration whereas "Eni Tsuku" (4.33±0.12 g/100g c.p) had the highest concentration. The valine concentration of each soup was significantly different ($p<0.05$) from the other soups. The concentration of methionine in the soups indicate that "Eni kpanmi (2.32±0.03 g/100g c.p) had the highest value, followed by "Eni emagi" (2.26±0.06 g/100g c.p) and "Eni kuka" ((1.46±0.09 g/100g c.p) had the lowest concentration. Threonine concentration obtained for "Eni kpanmi" (3.90±0.03 g/100g c.p) was the highest while "Eni nungbere" (3.03±0.11 g/100g c.p) had the least concentration. The threonine concentration of "Eni nungbere" was significantly different ($p<0.05$) from the other soups. The mean values for histidine ranged from 1.90±0.04 – 2.66±0.03 g/100g c.p, "Eni ezowa" (1.90±0.04 g/100g c.p) and "Eni kpanmi" (2.66±0.03 g/100g c.p) had the least and highest concentrations respectively.

Table 8: Essential Amino Acids Composition of Commonly Consumed Native Soups among Nupe People of Niger State (g/100g crude protein dry weight)

Soups	Leu	Lys	Ile	Phe	Try	Val	Met	Thr	His
Eni Kuka"	6.05±0.19^{a}	3.44±0.06^{a}	3.60±0.08^{a}	3.93±0.14^{a}	0.87±0.03^{a}	3.99±.22^{bc}	1.46±0.09^{a}	3.22±.12^{ab}	2.02±0.07^{b}
"Eni Nungbere"	8.01±0.09^{e}	4.05±0.11^{b}	4.37±0.04^{d}	3.90±0.00^{a}	1.17±0.08^{c}	3.93±.06^{bc}	2.24±0.06^{d}	3.03±0.11^{a}	2.34±0.03^{d}
"Eni Ezowa"	7.02±.09^{bc}	3.59±0.13^{a}	3.99±.13^{bc}	5.03±0.09^{c}	1.01±0.08^{b}	3.62±0.06^{a}	1.64±0.06^{b}	3.83±0.17^{c}	1.90±0.04^{a}
"Eni Emagi"	7.47±0.15^{d}	4.07±0.27^{b}	3.91±.09^{ab}	3.84±0.27^{a}	0.91±0.03^{a}	3.80±.18^{ab}	2.26±0.06^{d}	3.37±0.14^{b}	2.04±0.11^{b}
"Eni Tsuku"	7.08±0.21^{c}	4.45±0.06^{c}	3.71±0.16^{a}	4.46±0.36^{b}	0.91±0.03^{a}	4.33±0.12^{d}	1.99±0.11^{c}	3.74±0.03^{c}	2.17±0.07^{c}
"Eni Kpanmi"	6.79±0.04^{b}	7.05±0.06^{d}	3.73±0.07^{a}	3.99±0.09^{a}	0.91±0.03^{a}	4.11±.09^{cd}	2.32±0.03^{d}	3.90±0.03^{c}	2.66±0.03^{e}

Values are Mean ± S.D of triplicate determinations.

Value with different superscripts down the column are significantly different ($p<0.05$).

Lue: Luecine; Lys: Lysine; Ile: Isoleucine; Phe: Phenylalanine; Try: Tryptophan; Val: Valine; Met: Methionine; Thr: Threonine; His: Histidine.

Table 9 shows the non-essential amino acids obtained from the analyzed soups. Cysteine concentrations of the soups revealed that "Eni kpanmi" (0.81±0.07 g/100gc.p) had the lowest value and "Eni nungbere" (1.55±0.09 g/100gc.p) had the highest concentrations. The concentration of cysteine for "Eni kpanmi" and "Eni nungbere" are significantly different ($p<0.05$) from the other soups. Alanine contents ranged from 3.94±0.08 - 5.59±0.04 g/100gc.p, with "Eni emagi" (3.94±0.08 g/100g c.p) having the least value while "Eni kpanmi" (5.59±0.04 g/100gc.p) had the highest concentration. "Eni kpanmi" (14.64±0.38 g/100gc.p) had the highest content for glutamic acid and "Eni kuka" (11.70±0.31 g/100gc.p) had the least value. Glycine concentration in the soups indicate that "Eni kpanmi" (6.36±0.05 g/100g c.p) had the highest content, followed by "Eni nungbere" (4.10±0.18 g/100g c.p) and "Eni emagi" (3.20±0.12 g/100g c.p) recorded the lowest concentration. Serine contents show that "Eni emagi" (4.32±0.11g/100g c.p) recorded the highest value whereas "Eni ezowa" (3.53±0.11 g/100g) had the least concentration. The serine concentration of "Eni emagi" and "Eni ezowa" are significantly different ($p>0.05$) from the other soups. Aspartic acid concentration ranges from 7.17±0.16 - 9.09±0.19 g/100g c.p, "Eni tsuku" (7.17±0.16 g/100g c.p) and "Eni kpanmi" (9.09±0.19 g/100g c.p) had the lowest and highest concentration respectively. The result revealed that the proline content for the soups was found to be highest in "Eni kpanmi" (4.33±0.12 g/100g c.p) whereas "Eni kuka" (3.37±0.10 g/100g c.p) had the lowest content. The proline concentration of "Eni kpanmi" was significantly different ($p<0.05$) from the other soups. "Eni nungbere" (6.60±0.10 g/100g c.p), had the highest concentration of arginine, followed by "Eni emagi" (5.91±0.10 g/100g c.p), and "Eni tsuku" (4.76±0.10 g/100g c.p) recorded the least content. Tyrosine content for "Eni tsuku" (2.87±0.20 g/100g c.p) was found to be the lowest and "Eni ezowa" (3.96±0.00 g/100g c.p) had the highest concentration. There was significant difference ($p<0.05$) in the concentration of "Eni tsuku" and "Eni ezowa" from the other soups.

Table 9: Non Essential Amino Acids Composition of Commonly Consumed Soups among Nupe People of Niger State (g/100g crude protein dry weight)

Soups	Cys	Ala	Glu	Gly	Ser	Asp	Pro	Arg	Tyr
"Eni Kuka"	1.05 ± 0.08^{b}	4.17 ± 0.16^{b}	11.70 ± 0.31^{a}	3.73 ± 0.68^{abc}	3.92 ± 0.07^{b}	7.48 ± 0.19^{b}	3.37 ± 0.10^{a}	5.73 ± 0.27^{bc}	3.49 ± 0.10^{cd}
"Eni Nungbere"	1.55 ± 0.09^{d}	4.60 ± 0.05^{c}	13.62 ± 0.16^{d}	4.10 ± 0.18^{c}	4.16 ± 0.11^{cd}	8.33 ± 0.09^{d}	3.45 ± 0.00^{a}	6.60 ± 0.10^{d}	3.10 ± 0.18^{ab}
"Eni Ezowa"	1.29 ± 0.07^{c}	5.05 ± 0.16^{d}	12.46 ± 0.08^{b}	3.81 ± 0.07^{bc}	3.53 ± 0.11^{a}	7.52 ± 0.10^{b}	4.06 ± 0.20^{c}	5.56 ± 0.20^{b}	3.96 ± 0.00^{e}
"Eni Emagi"	1.21 ± 0.00^{c}	3.94 ± 0.08^{a}	$12.67\pm.24^{bc}$	3.20 ± 0.12^{a}	4.32 ± 0.11^{d}	7.86 ± 0.16^{c}	4.06 ± 0.20^{c}	5.91 ± 0.10^{c}	3.73 ± 0.20^{de}
"Eni Tsuku"	1.05 ± 0.07^{b}	4.73 ± 0.09^{c}	13.02 ± 0.15^{c}	3.51 ± 0.15^{ab}	3.98 ± 0.19^{bc}	7.17 ± 0.16^{a}	3.79 ± 0.12^{b}	4.76 ± 0.10^{a}	2.87 ± 0.20^{a}
"Eni Kpanmi"	0.81 ± 0.07^{a}	5.59 ± 0.04^{e}	14.64 ± 0.38^{e}	6.36 ± 0.05^{d}	3.91 ± 0.08^{b}	9.09 ± 0.19^{e}	4.33 ± 0.12^{d}	5.82 ± 0.05^{bc}	3.33 ± 0.10^{bc}

Values are Mean±S.D of triplicate determinations.

Values with different superscripts down the column are significantly different ($p<0.05$).

Cys: Cysteine; Ala: Alanine; Glu: Glutamic acid; Gly: Glycine; Ser: Serine; Asp: Aspartic acid; Pro: Proline; Arg: Arginine; Tyr: Tyrosine.

Discussion

Evaluation of commonly consumed native soups among Nupe people of Niger state revealed high amount of water content, with the least moisture content found in "eni ezowa" and this was higher than the highest moisture content reported for soup [8], which had 57.88% in Uha soup. Much higher moisture contents had been reported for kuka and okro soups with 95.52 and 92.15% respectively [16]. High moisture content in soup indicates a short shelf life due to microbial spoilage. However, low moisture content in any food products, means that the food will have more concentrated nutrient and longer storage life [17]. The crude protein contents of the soups showed that "Eni kuka" had the highest content although not significantly different from the other soups. Soups need to be combined with other foods that are high in protein value so as to meet protein requirement [18]. Protein content reported in Achara soup was almost six times higher than the protein content in this present study [8] and this may suggests that Achara leaves is a good source of protein couple with other sources of protein used in the preparation. The high fat content obtained in "Eni nungbere" indicates high lipid biomolecules and can serve as a source of lipids that are important for body metabolism [21]. The fat contents in the soup will contribute to increase in the energy value of the soup. Dietary fats help to increase food palatability by absorbing and retaining the flavors [23]. Fat is necessary in diet because it serves several vital metabolic functions [7]. High ash content obtained for "Eni kuka" suggests that the soup may be a better source of mineral to the body when eaten. Although, the ash content obtained in this present study was lower than the value reported for "ofe-ose" soup (6.25%) [8]. Total carbohydrate contents of all the soups were low but "Eni ezowa" had the highest content, which means the value can contribute to energy of the soup. The value of "eni ezowa" was higher than the carbohydrate content reported for miyan kuka (9.82%) [22]. But the miya kuka value was higher than the value obtained for "eni kuka" in this present study. Carbohydrate is important to the body as a source of fuel and energy that is required to carry out daily activities. The high energy level in "Eni nungbere" soup was significantly higher ($p<0.05$) when compared to other soups and this might due to high fat content in the soup.

Proteins during digestion are broken down to amino acids by enzymes in the digestive tract [7]. The essential amino acids obtained in this study were within the values reported for lysine (4.2 g/100g), threonine (2.8 g/100g), valine (4.2 g/100g), methione (2.2 g/100g), phenylalanine (2.8 g/100g) and isoleucine (4.2 g/100g) [19]. The body need to receive all the essential amino acids in a single day and persistent lack of these essential amino acids may prevent synthesis of protein; hence result in protein-deficiency diseases [7]. Essential amino acids obtained in "Eni emagi", "Eni tsuku" and "Eni nungbere" were higher when compared to essential amino acids in vegetables reported in south west of Nigeria [20]. These essential amino acids cannot be synthesis in the body and therefore are obtained from diets. Isoleucine concentration in "eni nungbere" was higher than the other soups and this essential amino acid is needed for the production of haemoglobin and to regulate the blood sugar level in the body. It is responsible for muscle recovery after exercise. Deficiency of isoleucine can lead to symptoms similar to those of hypoglycemia [24]. Methionine content was higher in "eni kpanmi" (fresh okra soup) which means it can contribute to synthesis of choline. Methionine is needed for the synthesis of choline which forms lecithin and other phospholipids in the body when diet is low in protein for instance in kwashiorkor or alcoholism, insufficient choline may be formed, this may cause accumulation of fat in the liver [24].

Conclusion

The macronutrients and the essential amino acids of the soups are in appreciable amount that could help contribute to daily nutrient intake and prevent protein deficiency related diseases. The findings also provide nutrient composition data on Nupe native soups which could contribute to nutrients data in Nigeria food composition

database.

Authors' contributions
The work was carried out in collaborations with all the authors. All authors read and approved the final manuscript.

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Authors declare that they have no conflict of interest

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Availability of data and materials
All data related to this manuscript are presented within the text.

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