# Proximate and Mineral Composition of Commonly Consumed Pasta Dishes among Adolescents and Young Adults in Abeokuta, Ogun State, Nigeria

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***ABSTRACT***
***Background:*** *The craving and transition of adolescents and young adults towards convenient and easy-to-cook foods has increased over the years. Hence, the need to provide nutrient data on the different forms of pasta dishes commonly consumed.*
***Objective:*** *This study standardized and determined the proximate and mineral contents of commonly consumed pasta dishes among adolescents and young adults in Ogun state.*
***Methods:*** *A cross-sectional research design was adopted, data on consumption patterns and recipes of commonly consumed pasta dishes were obtained from four hundred purposively selected undergraduates attending three public tertiary institutions in Ogun State using a semi-structured questionnaire. Recipes were standardized and the five commonly consumed pasta dishes were prepared and analyzed for proximate and mineral content using standard methods. Data were analyzed using percentage, median, and standard deviation. The daily value (DV) was calculated.*
***Results****: Over half (54.8%) undergraduates consumed pasta dishes as the main meal for at last 1-3 times/week Moisture, carbohydrate, protein, crude fiber and ash contents ranged from 24.64-33.50 g/100g, 24.18-38.56 g/100g, 11.04-17.67 g/100g, 0.68-2.59 g/100g and 2 2.21-4.02 g/100g respectively. Also, the calcium content of the dishes ranged from 60.66-107.48mg/ 100g and contributed to about 8% DV, sodium content ranged from 530.15-1152.58 mg/ 100g and contributed 50% DV, iron content ranged from 9.98-17.47 mg/ 100g and contributed 97% of DV and zinc content ranged from 3.42-5.16 mg/ 100g and contributed about 47% DV.*
***Conclusion:*** *Pasta dishes have good nutritional quality and will contribute significantly to recommended daily value if habitually consumed.*

**Keywords:** Standardization; Nutrient composition, Pasta

## Introduction

Pasta (Italian for dough) is a generic term for the Italian variant of noodles. Pasta and noodles are occasionally used interchangeably because products are the same and mainly produced from wheat processing [1]. Pasta is a staple food in several countries; they differ in their products, place of origins, raw materials used for production, the composition of ingredients, industrial procedures, and eating patterns [2]. Food products like pasta and noodle have existed for more than a millennium and significant function in human beings' nutritional and societal

values [3]. The global consumption of these products has increased and this be attributed to the ease of cooking, convenience, relatively low cost, and longer shelf life. . Wheat-based product has been on the increase among Nigeria population [4], and according to World Instant Noodles Association, Nigeria is rated 12th globally for instant noodles, with the consumption of up to locals consuming 1.76 billion noodles annually [5]. Wheat-based products such as noodles have become a favorite meal in many homes in Africa, especially among children and students of tertiary institutions. For efficient assessment of the nutritional status and planning of meals for general and therapeutic purposes, there is a need to provide nutrient information on the meals they commonly consume meal such as pasta [6]. Many of the food composition data available consist of few data on the micro nutrient contents of cooked foods widely consumed in Nigeria and this has posed an excellent challenge for Dietitian and Nutritionist who are involved in planning of meals for managing health and diseases. Therefore, this study aims to assess the nutrient composition of commonly consumed pasta dishes among students of tertiary institutions.

## MATERIALS AND METHODS

### Research design
This study adopted a cross-sectional research design

### Area of the study
The study was carried out in Abeokuta, the State capital of Ogun State in Southwest Nigeria. It is situated on the east bank of the Ogun River, near a group of rocky outcrops in a wooded savanna;77 kilometers (48 mi) north of Lagos by railway. There are five tertiary institutions within the city, two private universities, one federal university of agriculture, one polytechnic, and a college of education [7].

### Recipe Collection
A semi-structured, interviewer-administered questionnaire was used to obtain information on consumption patterns and recipes of commonly consumed pasta dishes, from 400 purposively selected undergraduates who were students in the three public tertiary institutions in Abeokuta who commonly consumed pasta dishes. Respondent's consent was sought and only willing participants were involved in the study. Information was collected on the ingredients, ingredients quantity (using household measures), methods of preparation, cooking time, and technique.

### Recipe collation and Standardization
The ingredients used by the majority of the respondents in preparing each dish were collated, the average ingredient quantity and cooking time used by the majority of the respondents were calculated as described by Akinbule et. al., [8]. The cooking temperature was described as low, medium, and moderate heat. The common method of preparation, the freshness of ingredients, and cooking technique as reported by the respondents were used to prepare the pasta dishes.

### Ingredient Purchase, Sample Preparation, and Treatment
Ingredients used for the preparation of the pasta dishes were purchased from Osiele Market in Abeokuta, Ogun State, Nigeria. The dishes were prepared at the Food Preparation Laboratory of the Department of Nutrition and Dietetics, Federal University of Agriculture, Abeokuta, using the standardized recipe. Description ingredients of the standardized recipe are shown below. After preparation, the dishes were cooled and approximately 200g of each pasta dish were separately homogenized. An aliquot was used to determine the moisture content of the dishes. Samples were dried in an oven at 105℃ for 12 hours and packaged separately in plastic bags, labeled, dated, and then kept frozen for further analysis.

### Standardized recipe of the commonly consumed Pasta dishes

### Boiled noodles and boiled egg
Noodles (154g), boiled with water ( 500ml), vegetable oil (5g), onion (50g), seasoning in the noodle sachet for 10 minutes, and served with egg (70g) boiled with water for 10 minutes.

### Jollof noodles and fried Egg
Noodles (140g), boiled with water (400ml), vegetable oil (10g), grated onion (20g), bell pepper (5g), tomatoes (40g), seasoning in the noodle sachet for 10 minutes, and served with egg (70g) fried with vegetable oil ( 20g), onion (10g), bouillon cube (2g) and salt (1g) for 1 minute.

### Jollof noodles, Boiled egg, and plantain
Noodles (145g), boiled with water (450ml), vegetable oil (10g), grated onion (50g), tomatoes (40g), bell pepper (4g), seasoning in the noodle pack for 12 minutes, and served with egg (70g) boiled with water and plantain (140g) diced and fried with vegetable oil (50g) for 10 minutes.

**Jollof spaghetti and boiled egg**
Spaghetti (260g) boiled with water (750ml), vegetable oil (80g), chili pepper (30g), tomato paste (18g), onion (60g), bouillon cube (16g), curry (1g), thyme (1g), salt (5g) for 45minutes and served with egg (70g) boiled with water for 10minutes.

**Jollof spaghetti, boiled egg, and plantain**
Spaghetti (282g) boiled with water (750ml), vegetable oil (80g), chili pepper (30g), tomato paste (35g), onion (60g), bouillon cube (16g), curry (1g), thyme (1g), salt (10g) for 45minutes and served with egg (70g) boiled with water for 10minutes and plantain (140g) fried with vegetable oil (40g) for 5 minutes.

**Determination of proximate and mineral contents of dishes**
Moisture (actual and residual), ash, fat, protein, crude fiber, and minerals (calcium, magnesium, potassium, iron, sodium, and zinc) were determined according to the method of AOAC [10]. Moisture was determined using the hot air oven method at 100 ℃ for 12 hours. Crude protein and fat were determined by the Kjeldahl procedure and the Soxhlet solvent extraction method, respectively. Ash was determined by incineration of the sample in a muffle furnace at 550℃ for six hours. Total carbohydrate was calculated by difference 100- (moisture + protein + fat +ash + crude fiber). Mineral elements were determined using the Atomic Absorption Spectrophotometer (bulk scientific; model: 2010). Sodium, potassium, and magnesium were determined using flame photometer model PFP7, Jenway, England. All samples were analyzed in duplicates.

**Calculation of Daily Value**
The nutritional quality of the standardized pasta dishes was calculated in terms of the nutrient content of the food to the daily value requirements set by the U.S Food and Drug Administration [9]. Based on a caloric intake of 2,000 calories, for adults and children four or more years of age for food labeling. The quantity of nutrients was compared to the list of daily values of individual nutrients and expressed as a percentage.

%DV supplied by pasta dishes =
(actual quantity of nutrient/appropiate daily value)
x 100

**Statistical Analysis**
All data obtained from the chemical analysis were presented as percentages, means, and standard deviations. Contributions of dishes to Recommended daily value (DV) were calculated in percentage.

**RESULTS**
**Frequency of consumption of pasta among respondents**
Table 1 shows the consumption frequency of pasta dishes. The most preferred pasta is noodles (49.1%), with the least select macaroni (3.7%). About 73.8% preferred pasta dish as the main meal while 26.2% preferred it as a snack. Among the study population, 54.8% consumed pasta 1-3 times a week, while 2.0% consumed pasta once a month. The time of consumption is mostly during breakfast (39.0%) while others preferred it after lunch (1.5%). Nine patterns of noodles and spaghetti-based dishes were observed with two macaroni-based pasta dishes. The reason for the choice of pasta varied among respondents; 64.8% gave taste as their reason.

**Proximate content of commonly consumed pasta dishes in g/ 100g**
The proximate composition of the dishes is shown in Table 2. Jollof spaghetti and boiled egg had the highest carbohydrate content (38.6 g/100g), while Jollof noodles, boiled egg, and plantain were the lowest (24.2 g/100g). The highest protein content was observed in Jollof spaghetti and boiled egg and plantain (17.7 g/100g) and lowest (11.0 g/100g) in boiled noodles and boiled egg. Fat content was highest in Jollof noodles and fried egg (28.2 g/100g) and lowest in Jollof spaghetti and boiled egg (18.6 g/100g). Crude fiber also varied among pasta dishes with Jollof noodles, boiled egg, and plantain having the highest (2.6 g/100g) while boiled noodles with boiled egg had the lowest (0.7 g/100g). Jollof noodles and fried eggs (403.8 Kcal/100g) supplied the highest amount of energy and Boiled noodles and boiled eggs had the lowest (352.1Kcal/100g) amount of energy.

**Percentage contribution of micronutrient values of pasta dishes to daily value**
Table 4 shows the percentage contribution of each dish to the recommended daily value (DV). 100 grams serving of the different dishes contributed 4.7-8.3% of Calcium; 14.6-19.9% of Magnesium; 3.2-5.2% of Potassium; 23.1-50.1% of Sodium; 55.4- 97.1% of Iron and 31.1-46.9% of Zinc respectively

**Table 1: Consumption pattern of Pasta Dishes**

| | Frequency | Percentage (%) |
|---|---|---|
| **Pasta Preferred** | | |
| Noodles | **196** | **49.1** |
| Spaghetti | 189 | 47.2 |
| Macaroni | 15 | 3.7 |
| **Preference** | | |
| Snack | 105 | 26.2 |
| Main meal | **295** | **73.8** |
| **Frequency of consumption** | | |
| Everyday | 114 | 28.5 |
| 1-3 times a week | **219** | **54.8** |
| 4-6 times a week | 48 | 12.0 |
| Once in a month | 8 | 2.0 |
| Others | 11 | 2.7 |
| **Time of consumption** | | |
| Breakfast | **156** | **39.0** |
| Brunch | 63 | 15.8 |
| Lunch | 122 | 30.5 |
| After lunch | 6 | 1.5 |
| Dinner | 46 | 11.5 |
| Bedtime meal | 7 | 1.8 |
| **Forms of pasta preparation** | | |
| Jollof noodles and boiled egg | 36 | 9.0 |
| Jollof noodles, boiled egg, and plantain | 74 | 18.5 |
| Jollof noodles and fried egg | 32 | 8.0 |
| Jollof noodles, fried egg, and plantain | 4 | 1.0 |
| Boiled noodles and boiled egg | 48 | 12.0 |
| Boiled noodles and fried egg | 4 | 1.0 |
| Fried noodles and boiled egg | 2 | 0.5 |
| Fried noodles and fried egg | 4 | 1.0 |
| Vegetable noodles and fried egg | 18 | 4.5 |
| Boiled spaghetti, stew, and plantain | 8 | 2.0 |
| Boiled spaghetti, stew, and boiled egg | 22 | 5.5 |
| Boiled spaghetti, stew, and stewed fish | 2 | 0.5 |
| Jollof spaghetti boiled egg and plantain | 40 | 10.0 |
| Jollof Spaghetti and stewed fish | 4 | 1.0 |
| Jollof spaghetti and boiled egg | 50 | 12.5 |
| Jollof spaghetti and fried egg | 2 | 0.5 |
| Jollof Spaghetti and plantain | 2 | 1.5 |
| Jollof spaghetti and fried fish | 18 | 4.5 |
| Vegetable macaroni and fried fish | 24 | 6.0 |
| Salad | 2 | 0.5 |
| **Reason for choice of pasta** | | |
| Taste | **259** | **64.8** |
| Advertisement | 32 | 8.0 |
| Emotion | 45 | 11.2 |
| Price | 24 | 6.0 |
| Time of cooking | 39 | 9.7 |
| Others | 1 | 0.3 |

**Table 2:** Proximate composition of standardized pasta dishes ( g per 100 g fresh weight)

| | Moisture content | Carbohydrate | Protein | Fat | Crude fiber | Ash | Energy (Kcal) |
|---|---|---|---|---|---|---|---|
| **BNBE** | 33.00 ± 0.33$^{d}$ | 32.17 ± 1.54$^{bc}$ | 11.04 ± 0.11$^{a}$ | 19.92 ± 0.13$^{d}$ | 0.68 ± 0.01$^{a}$ | 2.21 ± 0.04$^{a}$ | 352.08 ± 4.55$^{a}$ |
| **JNFE** | 29.55 ± 0.84$^{e}$ | 25.13 ± 0.10$^{bc}$ | 12.31 ± 0.07$^{e}$ | 28.23 ± 0.59$^{a}$ | 1.77 ± 0.04$^{e}$ | 3.02 ± 0.05$^{b}$ | 403.81 ± 5.4$^{c}$ |
| **JNBEP** | 33.50 ± 0.17$^{b}$ | 24.18 ± 0.29$^{a}$ | 11.72 ± 0.12$^{c}$ | 24.26 ± 0.11$^{e}$ | 2.59 ± 0.06$^{bd}$ | 3.76 ± 0.06$^{e}$ | 361.88 ± 0.29$^{d}$ |
| **JSBE** | 24.64 ± 0.37$^{ac}$ | 38.56 ± 0.42$^{de}$ | 12.36 ± 0.02$^{bd}$ | 18.57 ± 0.12$^{c}$ | 1.87 ± 0.03$^{bd}$ | 4.02 ± 0.07$^{c}$ | 370.79 ± 0.50$^{e}$ |
| **JSBEP** | 25.85 ± 0.36$^{ac}$ | 37.30 ± 0.33$^{de}$ | 17.67 ± 5.57$^{bd}$ | 19.46 ± 1.44$^{b}$ | 1.34 ± 0.24$^{c}$ | 3.31 ± 0.03$^{d}$ | 382.87± 0.42$^{b}$ |

Note: Values are given as mean ± standard deviation (S.D.).
Values on the same column having different superscripts are significantly different at $p< 0.05$
**BNBE**: Boiled Noodles and Boiled Egg; **JNFE**: Jollof Noodles and Fried egg; JNBEP: Jollof Noodles, Boiled egg, and plantain;
**JSBE**: Jollof Spaghetti and Boiled Egg; **JSBEP:** Jollof Spaghetti, boiled egg, and plantain

**Table 3:** Mineral contents of standardized pasta dishes (per 100g fresh weight)

| | Calcium (mg) | Magnesium (mg) | Potassium (mg) | Sodium (mg) | Iron (mg) | Zinc (mg) |
|---|---|---|---|---|---|---|
| **BNBE** | 94.26 ± 0.10$^{b}$ | 78.46 ± 0.55$^{bc}$ | 245.08 ± 1.16 | 960.41 ± 7.26$^{b}$ | 17.47 ± 0.11$^{c}$ | 5.16 ± 0.02$^{b}$ |
| **JNFE** | 60.66 ± 0.74$^{e}$ | 61.93 ± 0.76$^{bc}$ | 148.16 ± 1.60 | 530.15 ± 6.47$^{c}$ | 11.55 ± 0.27$^{be}$ | 3.42 ± 0.08$^{e}$ |
| **JNBEP** | 85.80 ± 0.09$^{c}$ | 61.35 ± 0.43$^{e}$ | 190.58 ± 0.18 | 670.89 ± 0.68$^{e}$ | 9.98 ± 0.05$^{be}$ | 4.21 ± 0.04$^{c}$ |
| **JSBE** | 107.48 ± 0.72 $^{a}$ | 83.47 ± 0.99$^{a}$ | 183.01 ± 0.77 | 1152.58 ± 3.98$^{a}$ | 12.49 ± 0.16$^{d}$ | 4.33 ± 0.04$^{d}$ |
| **JSBEP** | 81.79 ± 0.81$^{d}$ | 70.44 ± 0.42$^{d}$ | 156.52 ± 0.42 | 865.62 ± 6.98$^{d}$ | 11.33 ± 0.09$^{a}$ | 3.71 ± 0.04$^{a}$ |

Note: Values are given as mean ± standard deviation (S.D.).
Values on the same column having different superscripts are significantly different at $p< 0.05$
**BNBE**: Boiled Noodles and Boiled Egg**; JNFE**: Jollof Noodles and Fried egg; **JNBEP**: Jollof Noodles, Boiled egg, and plantain;
**JSBE**: Jollof Spaghetti and Boiled Egg; **JSBEP**: Jollof Spaghetti, boiled egg, and plantain

**Table 4:** Contribution of micronutrient values of pasta dishes to daily value

| Dishes | Carbohydrate | Protein | Fat | Calcium | Magnesium | Potassium | Sodium | Iron | Zinc |
|---|---|---|---|---|---|---|---|---|---|
| **BNBE** | 11.7 | 22.1 | 25.5 | 7.3 | 18.8 | 5.2 | 41.8 | 97.1 | 46.9 |
| **JNFE** | 9.1 | 24.6 | 36.2 | 4.7 | 14.7 | 3.2 | 23.1 | 64.2 | 31.1 |
| **JNBEP** | 8.8 | 23.4 | 31.1 | 6.6 | 14.6 | 4.1 | 29.2 | 55.4 | 38.3 |
| **JSBE** | 14.0 | 24.7 | 23.8 | 8.3 | 19.9 | 3.9 | 50.1 | 69.4 | 39.4 |
| **JSBEP** | 13.6 | 35.3 | 24.9 | 6.3 | 16.8 | 3.3 | 37.6 | 62.9 | 33.7 |

## DISCUSSION

This study showed that pasta was more consumed among the female respondents with a frequency of 1-3 times a week this agrees with the study of Fulgoni and Bailey –[10] which recorded consumers of pasta dishes as female but disagrees with the study of Huh *et al.,[11]* which recorded consumers of pasta to be male who with consumption of more than three times a week.

The moisture content was lower compared with the values (69.35-90.92 g /100 g fresh weight) found by Alaba and Adewunmi, [12] in the soups consumed in the South-West geopolitical zone of Nigeria and that of Maroua [13] in the recipe, proximate and mineral compositions of some traditional sauces consumed in the Far North Region of Cameroon but higher than values (0.61 to 2.79 g/100g) reported by Madueke *et al.,* [14] in the study on Microbiological analysis of street foods along lokoja- Abuja expressway, lokoja.

The ash content of a food sample gives an insight into the inorganic (mineral) content of the sample. The ash content of the dishes was lower than the values (4.2-6.6 g/100 g dry weight) reported by Madukorsiri and Adoga, [15] in some ready-to-eat foods commonly consumed by indigenes in Bassa of Plateau state of Nigeria. The protein content of the dishes varied from(8.71g -10.59 g/100 g fresh weight). These variations can be attributed to the type and quantity of ingredients used. The protein content recorded in this study were higher than those recorded by Onyema *et al.*,[16], who studied the quality of common instant noodles sold in the market, but lower than the protein content recorded by Randrianatoandro *et al.,* [17] in dishes prepared from green-leafy vegetables in an urban district of Antananarivo (Madagascar). Protein is necessary for building the structural components of the human body, such as muscles and organs [18]. Protein deficiency causes growth retardation, muscle wasting, edema, abnormal swelling of the belly, and collection of fluids in the body[19].

Most instant noodles are deep-fried to dry, so they are high in calories, refined carbohydrates, saturated fat, and sodium [11]. However, the carbohydrate content of dishes recorded in this study was lower than those recorded by Onyema *et al., [16]*, which are usually sources of energy given the raw material for their production (wheat flour). Studies that have analyzed minerals in pasta dishes on a composite-meal basis that could be used to compare with the present study results are scarce; nonetheless, the present study demonstrates the varying levels of the mineral contents in widely consumed pasta dishes. Due to the vast sociological and economic differences, food consumption varies and consequently influences nutrient contents of dishes and nutrient intake. Calcium is the most abundant mineral in the body and its function include regulating muscular contractions, including heartbeat, blood clotting, and formation of strong bones and teeth [20]. It is essential for bone development and the prevention of osteoporosis. The calcium content of dishes was generally higher compared with the values found by Maroua [13] in some Cameroonian household foods eaten in Douala. Still, it was, however lower compared to those reported by Onabanjp *et al., [6]* in Nigerian dishes.

The Magnesium content of the dishes was generally higher than the values found in some Cameroonian household foods eaten in Douala [13]. Magnesium is a constituent of bones, teeth, and enzyme cofactors [21]. The sodium content present in most of the dishes comes from the salt used in the recipes. The Sodium content of dishes was higher compared with a report by Madukorsiri and Adoga [15] in some ready-to-eat foods commonly consumed by indigenes in Bassa

LGA of Plateau state of Nigeria. Intake above the recommended value has been associated with high blood pressure and stiffening of arterial walls. Therefore, is a risk factor for coronary heart disease, which is a significant cause of death in the world [22]. People with high blood pressure should be restricted from high Sodium diets.

There is abundant evidence that a reduction in dietary sodium and increased potassium intake decreases Blood Pressure, the incidence of hypertension, and morbidity and mortality from Cardiovascular Disease [23]. For people with low potassium, improved diets or potassium supplements to prevent or treat some of these conditions may be recommended. The Iron content was higher than the values recorded by Kouebou *et al.,* [24] in some traditional sauces consumed in Ngali II (Centre Region of Cameroon). Iron is an essential trace element in the human body. It plays a crucial role in hemopoiesis, control of infection, and cell-mediated immunity [25]. The deficiency of Iron has been described as the most prevalent nutritional deficiency, and Iron deficiency anemia is estimated to affect more than one billion people worldwide [26]. Iron is the most common micronutrient deficiency in the world. Women of childbearing age are the highest-risk group because of menstrual blood losses, pregnancy, and lactation. Iron conveys the capacity to participate in redox reactions to several metalloproteins such as hemoglobin, myoglobin, cytochrome enzymes, and many oxidases and oxygenase. It is required for many proteins and enzymes, notably haemoglobin to prevent anaemia. Anaemia has been shown to be linked maternal mortality and premature child birth [27].

The Zinc content was higher than the values reported by Maroua [13] in some Cameroonian households' foods eaten in Douala. Zinc is an essential micronutrient for human growth and immune functions [28]. Higher consumption of dishes rich in zinc will significantly help in combating malnutrition and parasitic illnesses such as malaria. Zinc deficiency increases the level of Plasmodium falciparum in blood [29]. Zinc is such a critical element in human health of which a minor defect is a disaster. An estimated 20% of the world population is reported to be at risk of inadequate Zinc intake [30]. Zinc deficiency is characterized by growth retardation, loss of appetite, and impaired immune function. In more severe cases, Zinc deficiency causes hair loss, diarrhea, delayed sexual maturation, impotence, hypogonadism in males, and eye and skin lesions [31].

## CONCLUSION

This research provides information on the proximate and mineral composition of commonly consumed pasta dishes among tertiary students in Ogun State, Nigeria. It has established the varying amount of nutrients in these dishes. It has provided baseline data that will be useful in complementing food composition data available in Nigeria and in assessing the dietary intake of Nigerian students. All dishes also supplied varying amounts of micronutrients compared with the recommended daily value.

## RECOMMENDATION

Salt and other seasonings should be moderately used to keep sodium consumption minimal and reduce consequential health effects.


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## REFERENCES


1. Karim, R. and Sultan, M.T., (2014). Yellow alkaline noodles: Processing technology and quality improvement. Springer.
2. Fuad, T. and Prabhasankar, P., (2010). Role of ingredients in pasta product quality: A review on recent developments. Critical reviews in food science and nutrition, 50:787-798.
3. Qumbisa, N.D., (2019). Indigenizing instant noodles: an interface of traditional amaranthus leaves and wheat for improved food and nutrition security (Doctoral dissertation).
4. Adebowale, A.A., Adegoke, M.T., Sanni, S.A., Adegunwa, M.O. *et al.*, (2012). Functional properties and biscuit-making potentials of sorghum-wheat flour composite. American Journal of food technology, 7:372-379.
5. Ali, R.A.A., (2018). Impact of Cooking and Additives on the Chemical and Microbiological Characteristics of Indomie Noodles (Doctoral dissertation, Sudan University of Science and Technology).
6. Onabanjo, O.O., Sanni, S.A., Afolabi, W.A.O., Oyawoye, O.O. and Obanla, O.O., (2014). Lipid composition of some commonly consumed traditional Nigerian

dishes. Journal of Human Nutrition and Dietetics, 27:367-376.
7. Hoiberg, D.H., (2010). *Abeokuta*. Encyclopædia Britannica. I: A-ak Bayes (15th ed.). Chicago, IL: Encyclopædia Britannica Inc, p. 27.
8. Akinbule, O.O., Akinbule, A.S., Oladoyinbo, C.A., Omidiran, A.T., *et al.,* (2019). Standardization, Proximate Composition, Mineral Contents and Mineral Ratios of Selected Indigenous Soups in South-West, Nigeria. Nigerian Food Journal, 37:44-56.
9. Carey, C.C., (2020). The United States Food and drug administration, in Clinical Engineering Handbook. Elsevier.764-773.
10. Fulgoni III, V.L. and Bailey, R., (2017). Association of Pasta Consumption with Diet Quality and Nutrients of Public Health Concern in Adults: National Health and Nutrition Examination Survey 2009–2012. Current Developments in Nutrition, 1:e001271.
11. Huh, I.S., Kim, H., Joh, H.K., Lim, C.S., Kim, J.S., *et al.,*(2018). Erratum: Instant noodle consumption is associated with cardiometabolic risk factors among college students in Seoul. Nutrition research and practice, 12:173-173.
12. Alaba, K., & Adewunmi, H. O. (2019). Proximate Qualities of Commonly Consumed Traditional Dishes In southwest Nigeria. (Doctoral Dissertation).
13. Maroua, P. O. (2014). Recipes, proximate and mineral compositions of some traditional sauces consumed in the Far North Region of Cameroon. International Food Research Journal, 21:1589-1596.
14. Madueke, S. N., Awe, S., & Jonah, A. I. (2014). Microbiological analysis of street foods along Lokoja-Abuja expressway, Lokoja. American Journal of Research Communication, 2:196-211.
15. Madukorsiri, C. H., & Adoga, G. I. (2009). Some Nutrient Composition of Ready-to-Eat Foods Consumed by Pregnant and Lactating Women in Bassa LGA of Plateau State, Nigeria. Pakistan Journal of Nutrition, 8:1889-1893.
16. Onyema, C. T., Ekpunobi, U. E., Edowube, A. A., Odinma, S., & Sokwaibe, C. E. (2014). Quality assessment of common instant noodles sold in Nigerian markets. American Journal of Analytical Chemistry, 5:1174.
17. Randrianatoandro, V. A., Avallone, S., Picq, C., Ralison, C., & Trèche, S. (2010). Recipes and nutritional value of dishes prepared from green-leafy vegetables in an urban district of Antananarivo (Madagascar). International journal of food sciences and nutrition, 61:404-416.
18. James, O., & Emmanuel, U. C. (2011). Comparative studies on the protein and mineral composition of some selected Nigerian vegetables. African Journal of Food Science, 5:22-25.
19. Von Haehling, S., Ebner, N., Dos Santos, M. R., Springer, J., & Anker, S. D. (2017). Muscle wasting and cachexia in heart failure: mechanisms and therapies. Nature Reviews Cardiology, 14:323-341.
20. Pravina, P., Sayaji, D., & Avinash, M. (2013). Calcium and its role in the human body. International Journal of Research in Pharmaceutical and Biomedical Sciences, 4:659-668.
21. Soetan, K. O., Olaiya, C. O., & Oyewole, O. E. (2010). The importance of mineral elements for humans, domestic animals, and plants-A review. African journal of food science, 4:200-222.
22. Chue, C. D., Townend, J. N., Steeds, R. P., & Ferro, C. J. (2010). Republished paper: arterial stiffness in chronic kidney disease: causes and consequences. The postgraduate medical journal, 86:560-566.
23. Whelton, P. K. (2014). Sodium, potassium, blood pressure, and cardiovascular disease in humans. Current hypertension reports, 16:465.
24. Kouebou, C. P., Achu, M., Nzali, S., Chelea, M., *et al.,* (2013). A review of composition studies of Cameroon traditional dishes: Macronutrients and minerals. Food chemistry, 140:483-494.
25. Attar, T. (2020). A mini-review on the importance and role of trace elements in the human organism. Chemistry Review Letter, 3:117-130.
26. Khalafallah, A. A., & Dennis, A. E. (2012). Iron deficiency anemia in pregnancy and postpartum: pathophysiology and effect of oral versus intravenous iron therapy. Journal of pregnancy, 2012.
27. Musallam, K. M., & Taher, A. T. (2018). Iron deficiency beyond erythropoiesis: should we be concerned?. Current medical research and opinion, 34:81-93.
28. Maares, M., & Haase, H. (2016). Zinc and immunity: An essential interrelation. Archives of biochemistry and biophysics, 611:58-65.

29. Mbugi, E. V., Meijerink, M., Veenemans, J., Jeurink, P. V., *et al.,* (2010). Effect of nutrient deficiencies on in vitro T h 1 and T h 2 cytokine response of peripheral blood mononuclear cells to Plasmodium falciparum infection. Malaria Journal, 9:1-14.
30. Wessells, K. R., & Brown, K. H. (2012). Estimating the global prevalence of zinc deficiency: results based on zinc availability in national food supplies and the prevalence of stunting. PloS one, 7:e50568.
31. Deshpande, J. D., Joshi, M. M., & Giri, P. A. (2013). Zinc: The trace element of major importance in human nutrition and health. International Journal of Medical Science and Public Health, 2:1-6.