Proximate Analysis and Elemental Composition of Some Spiced and Unspiced Food Products Around Bwari Area Council Abuja, FCT

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Abstract:- **This study was carried out to investigate the Proximate Analysis and Elemental Composition of some Spiced(Spiced millet powder, Spiced dried okra, Spiced Swallow made from unripe plantain and wheat powder, Spiced bean powder) and Unspiced(Millet powder, dried okra, Bean powder and Swallow made from unripe plantain and wheat powder) Food Products from Bwari Area Council Abuja Using AOAC standard methods for the determination of Moisture content, Ash content; crude protein, Crude fibre, Carbohydrate e.t.c. Mineral composition and some trace element were also determined using Atomic Absorption spectrophotometric method and Inductive Coupled Plasma Atomic Emission Spectrometer (ICP AES). The average value of the moisture content, the protein content, the fat content, the ash content, the crude fibre, and carbohydrate of all the analysed spiced samples ranged as follows; (7.50-12.00%), (2.19-14.70%), (0.13 -4.36 %), (0.49 – 16.16%), (3.36- 6.64%), (69.92 % - 87.72 %) respectively. Also, the average elemental composition of the samples are in the range of; Fe(11.62 – 27.99 mg/kg), Mg(26.29 - 82.18 mg/kg), Zn(4.20 - 20.45 mg/kg), Ca(45.97-103.23 mg/kg), Mn(1.729 - 18.734) respectively. The moisture contents of the samples were found to be low thus making them to have a longer shelf life and less open to degeneration and spoilage by the action of mold and other microorganism which flourish well at higher moisture contents. The protein and carbohydrate contents were relatively high compared to other food samples. The mineral and trace metals composition were within the acceptable standards required by the body. This food samples have enough nutritional value to contribute to our health and solve the problem of malnutrition in Nigeria.**

Key Words: **Spiced, Unspiced, Millet, Elemental Composition, Proximate**

I. INTRODUCTION

Food is anything meant to give energy or nourishment to the body. It is any substance eating by living organisms to provide nutrient to the body [1]. It originated from plants and animals. Some of the components have to go through digestion to become beneficial to the body; some of the components might not digest [2]. Food can also be classified based on the types of nutrient it contains and its role in the body [3]. A nutrient is a compound needed by the body for energy, growth, basic physiological processes and the overall health. Also nutrient is a source of nourishment e.g food that can be hydrolyse by an organism to give energy and build tissue [4]. Nutrients are again divided into three; plant nutrient, animal nutrient and plant and animal nutrient mixed together. The first class of the nutrient is 'Rich', the second class of the nutrient is poor, while the third class is regarded as nutrient barren and they all serve different purposes in the body. This review will focus on plant nutrient.

Nutrition is the science that explains the interplay of nutrients and other food components in relation to maintenance, growth, reproduction, health and disease of an organism. Food intake, absorption, assimilation, biosynthesis, catabolism and excretion are included in this study [4].

The world is showing much interest in nutrition, fitness and beauty which has trigger concern over a healthy diet. Nutritional properties are forms of "functional" foods that can provide health benefits such as prevention of chronic diseases, as well as meeting basic nutritional requirements [5].

Nutrients are at the foundation of the nourishment and Foods are to the large extent made up of five main nutrients; carbohydrate, protein, fat, vitamins and minerals [6]. Carbohydrate, protein, and fat are the major parts of our diet and Vitamins and Minerals are needed in little quantity. These two categories are regarded as macro and micro nutrients respectively. However, water is considered a micronutrient because it does not contain energy [3]. The nutritional content of food varies depending on the mode of preparation [7]. Correct intake of food promised adequate supply of nourishment need of the body.

In developing country like Nigeria, malnutrition is common due to inability to afford the cost of nutritional food. There is an increasing gap between population explosion and nutritive food supply [8]. Food composition data are important for estimating energy and nutrients intake but are scanty [9].

This work will be conducted to evaluate nutritional properties or chemical composition and mineral composition of unspiced and spiced millet, beans, dried okra and unripe plantain powder and to create a repository necessary to know their nutritional contribution to our health. This is in promotion of the sustained interest in addressing the problem of malnutrition in Nigeria. Food products supplements have played a role in bridging the ever increasing gap between population vital statistics and nutritional food supply [7][8]. It will bring to light, nutritional values and expose the use of

spiced millet, beans, dried okra and unripe plantain powder as nutritious food. Positive outcome of this work can reduce the effect of food scarcity by giving more attention to the exploitation and utilization of common food products for improved nutritive values to meets the nutritional needs of the general populace

This work will cover preparation of unspiced and spiced millet, beans, dried okra and unripe plantain powder, determination of nutritional properties or chemical compositions of unspiced and spiced millet, beans, dried okra and unripe plantain powder will rely on: measuring the moisture, protein, ash, fibre, fat, CHO, vitamin and minerals.

II. MATERIALS AND METHODS

2.1 Sampling and Samples Preparation

Samples of Millet, Unripe plantain, beans, and Okra that are commonly consumed around the study area where collected in the month of January and March during the dry season from Bwari Central Market, which is one of the busiest market in FCT area. There were collected in plastic buckets and transported to the laboratory. Samples were milled into powder with Christy and Norris laboratory mill (Type: 8" lab mill) to pass through a 20 mm sieve.

2.2 Determination of moisture

Platinum dish was washed, dried, cooled and weighed (W_1), afterward 2 g of the test sample was added to the dish and the weight (W_2) was recorded. The dish and its content were placed in an oven and heated to dryness at 105^0C for about 3 hours and the weight (W_3) was recorded. The procedure was replicated until the difference between the two weights became constant. Percentage amount of moisture resulting from the drying was calculated using the following formula;

$$Moisture\ (\%) = \frac{(W_1 - W_2)}{W} \times 100\ \%$$

W_1 = Weight of sample with Petri dish before drying

W_2 = Weight of sample with Petri dish after drying

W = Weight of sample

2.3 Determination of ash content

Platinum dish washed, dried and cooled was weighed (w_1) and 2 g of the food sample was spread evenly in the dish and the new weight (w_2) recorded. The samples were dried in the water bath and char over hot plate in the fume cupboard until no more sooth is given off. Afterwhich it was transferred with a pair of tongs into a muffle furnace and heated at 550°C until it was fully ashed (colour changes to gray) and the weight (w_3) was recorded after cooling to a room temperature. The ash content was calculated using the formula:

$$Total\ ash\ content\ (\%) = \frac{weight\ of\ crucible\ with\ ash\ (g)}{weight\ of\ crucible\ with\ sample\ (g)} \times 100\ \%$$

2.4 Crude fat estimation

2 g of the sample was placed in a boiling tube and 10 ml each of distilled water and conc. HCl were added. The mixture was placed in a boiling water bath until it turned brown. After cooling, it was transferred into a separating funnel. 10ml of ethanol and 30 ml of diethyl ether were added and shaken and was allowed to stand for some minutes so as to separate into immiscible layers. Ether layer was decanted into a clean, dried and pre weighed conical flask. The extraction was replicated twice with 25 ml of diethyl ether and the extract was evaporated in a water bath. The fat was dried at 105°C in an oven, cooled and weighed (w_2).

$$Crude\ fat\ (\%) = \frac{W_2 - W_1}{W} \times 100\ \%$$

2.5 Determination of crude proteins

The protein measurement test was based on the nitrogen content (Kjeldahl method). 1 g of sample and digestion mixture (copper sulphate + potassium sulphate) was weighed into a Kjeldahl flask and 25 mL of concentrated H_2S0_4 was added. A spatula-full of CuSO4 salt was added, as well as 25ml of concentrated H_2SO_4 solution. A reasonable amount of anti bump was added to the digestion flask which was connected to a glass tube (with a condenser neck-off) whose joint was rubbed with Vaseline. The digestion system was connected to the lower chamber of the Kjeldahl apparatus and the heat knob was switch on. Sample was heated until a clear solution was obtained.

200 ml of distilled water and 85ml of 50% NaOH solution were added to the digest. The measuring cylinder used to measure the NaOH solution, was rinsed with 50ml distilled water and the content transferred to the digestion flask. Anti bump was again added and the distillation framework and was connected to the upper chamber of the apparatus. 50 ml of 2 % H_3BO_3 was measured and transferred into a receiving flask. 3 drops of screened methyl red indicator were added. The receiving flask was placed at the middle chamber of the apparatus, and the delivery tube was immersed into the pinkish solution in the receiving flask. The heat knob of the upper chamber was switch on for distillation to begin, and about 200ml of the resulting bluish solution was collected for titration.

Amount of nitrogen in the samples was calculated using the following equation:

$$Nitrogen\ (\%) = \frac{14 \times Normality\ of\ HCl \times \Delta V \times 100}{weight\ of\ sample \times 1000}$$

% protein = % of Nitrogen × 6.24

2.6 Determination of Carbohydrate

Carbohydrate was obtained by difference method and was expressed as percentage of carbohydrate.

$$Carbohydrate\ (\%) = 100 - [Moisture + Ash + Fat\ Protein]$$

2.7 Determination of Crude fiber

Crude fiber waa determined as described by Kotue *et al*. (2018); 1 g of sample was taken into the beaker. 60 mL of boiling sulfuric acid was added, and was connected with the digestion apparatus. It was allowed to boiled for exactly 30 min, filtered through filtering cloth and washed with hot water until it was free from acid. The residue on the cloth was transfered into the flask with 200 mL of boiling sodium hydroxide solution. The flask was immediately connected with the digestion apparatus and boil further for exactly 30 min. The flask was removed and the content was immediately filtered through Gooch crucible. The filtrate was washed with hot water until it was freed from alkali by adding 10 mL of alcohol. It was dried at 105-110 ℃ in an air and in an oven for about 2 hr. It was cooled to room temperature in a desiccators and weighed. The process was repeated for 30 minutes, drying, cooling and weighing until the difference between two successive weight was less than 1 mg. The lowest weight was noted was considered as the weight of crucible and contents after drying.

The contents in the crucible were incinerated in an electric muffle furnace at 620℃ for about 30 minutes. It was cooled to room temperature in desiccators and weighed. The process was repeated until the difference between two successive weighing is less than 1 mg. The lowest weight was noted and considered as the weight of crucible and ash after incinerating. The difference between the two weightings was the weight of crude fibre.

$$Crude\ fibre\ (\%\ by\ weight) = \frac{(W_1 - W_2)}{W} \times 100\ \%$$

W = Sample weight (g)

W_1 = Crucible and contents weight after drying (g)

W_2 = Crucible and ash weight after incinerating (g)

2.8 Insoluble and soluble dietary fibers

Enzymic-gravimetric methods were used to determine insoluble dietary fiber content and soluble dietary fiber content was calculated by difference using crude fiber result. A-amylase (Termamyl 120L), protease (Flavourzyme) and amyloglucosidase (AMG 300L) were employed to determine the dietary fibre. Soxhlet's method was used to enzymatically extract the fiber from fat- extracted samples. The dry sample was homogenized with 40 mLMES/TRIS (pH 8.2) solution and α-amylase solution was added. The mixture was heated at 95 ℃ in a water bath. Afterward, the mixture was cooled to room temperature and wash with distilled water. Protease solution was added at 60℃ in a water bath and then mixed with 5 mL of 0.56M HCl solutions, adjust to pH 4.0. After then, 300 ul of amyloglucosidase solution was added and stirred at 60 ℃ on a hot plate. The solution was filtered using glass filter, with 1 g celite, and the filtrate was washed with 78 % ethanol, 95 % ethanol and acetone in turn to extract the insoluble fibre. After leaving it to stand overnight, the residue in the glass filter was weighed for the insoluble fibre. The filtrate collected was added to 95 % ethanol and distilled water. For extract of soluble fibre, the solution was filtered using a glass filter with celite and the filtrate was washed with 15 mL of 78 % ethanol, 95 % ethanol and acetone, in turn. After overnight, the residue in the glass filter was weighed for the soluble fibre.

2.9 Mineral Composition and Trace Elements

2.9.1 Digestion of the Sample

1g of the food samples were taken in digesting glass tubes. 12 mL of HNO_3 was added to the food samples and the mixtures were kept for overnight at room temperature. Then 4 mL perchloric acids (HClO) were added to the mixtures and were heated in the Fume cupboard for digestion. The temperature was increased gradually from 50℃ and up to 250-300 ℃. The digestion was completed in about 70-85 min as indicated by the appearance of white fumes. The mixture was cooled and the contents of the tubes were transfer to 100 mL volumetric flasks and the volumes of the contents were made to 100 mL with distilled water. The wet digested solution was transferred to plastic bottle in 10 min. Supernatants was used for mineral determination using Atomic Absorption Spectrometry/Flame Photometry according to the methods AOAC (2003).

2.9.2 Determination of Magnesium (Mg), Calcium (Ca), Iron (Fe), Zinc (Zn) and Manganese (Mn) using Inductive Coupled Plasma Atomic Emission Spectrometer (ICP AES)

Shimadzu's ICPE-9000 Inductively Coupled Plasma Atomic Emission Spectrometer (ICP AES) was used for the analysis of chemical contaminants. A dry cool platinum dish was accurately weighed as (W1) and about 2g of the food sample was spread evenly in the dish and weighed as (W2). Then it was transferred using a pair of tongs into a muffle furnace at 550ºC until fully ashed (colour changes to gray) and weighed as (W3). 5ml of high purity nitric acid was added to the resulting ash. The dish was heated for approximately 30 minutes on a hot plate covered with a watch glass at a temperature just below boiling. After which it was left to cool to room temperature, it was then be transferred to 100ml volumetric

flask and made up to mark with a deionized water, and was used for analysis. The elements to be measured were also added to the water to create a spike-and recovery test solution. For elements present in high concentration, dilution test solutions were prepared by diluting 10-fold with 1 % nitric acid solution. Calibration curve samples were prepared by diluting and mixing appropriate amounts of mixed standard solution and single element standard solution as stipulated by Shimadzu (2016). The prepared standard solutions and the food samples were injected into the ICP AES equipment after all the analytical conditions were set and the instrument was ready for analysis. After analysis, calibration curves were created and the peak concentration for the samples was correlated

automatically with the calibration curve and the element concentration determined.

III. RESULTS AND DISCUSSION

3.1 Results of the chemical composition of Unspiced

(Millet powder, dried okra, Bean powder and Swallow made from unripe plantain and wheat powder) **pure food samples and Spiced** (SMP-Spiced millet powder, SDO-Spiced dried okra, SSW-Spiced swallow made from unripe plantain and wheat powder, SBP-Spiced bean powder) **food Samples**

The chemical composition results of moisture, crude protein, fiber, ash, fat content and carbohydrate of some Unspiced and spiced foods are as shown below in table 1.0 and 2.0 respectively

Table 1.0: Result of Proximate Evaluation of Blend of Spices and Spiced Samples

Sample	Moisture %	Protein %	Ash %	Fibre %	Fats %	CHO %
Spices	13.00	4.03	16.16	8.40	0.72	66.09
SMP	12.82	2.19	0.49	6.64	0.38	87.72
SBP	12.00	14.18	1.99	3.36	1.91	69.92
SSW	7.35	5.08	1.01	5.33	0.13	86.43
SDO	10.90	2.45	3.09	6.22	4.36	79.20

Table 2.0: Result of Proximate Evaluation of the unspiced pure food samples

SAMPLE	% Moisture	%Protein	% Ash	% Fibre	% Fat	% CHO
Millet Powder	**9.22**	**8.73**	**3**	**2**	**2.63**	**70.82**
Bean Powder	**7.06**	**14**	**2.2**	**4**	**7.88**	**64.86**
Dried Okra Powder	**7.23**	**10.49**	**0.8**	**2.2**	**19**	**39.72**

3.1.1 Moisture

The spiced bean powder (SBP) had the highest moisture content of 12.00 % while spiced swallow (SS) had the lowest moisture content of 7.35 % (Table 4.1). This shows that, Spiced swallow (SS) had the least number of water molecules incorporated into its. The low moisture content (7. 35 %) for spiced swallow (SS) will contribute to a longer shelf life making it less open to degeneration and spoilage as a result of the action of mold and other microorganism that grow well at higher moisture contents[10]. The moisture content (7.35 %) spiced swallow (SS) is lower when compared to the moisture content for spiced millet powder (SMP), spiced bean powder (SBP) and spiced okra powder (SOP) which are 9.22 %, 12. 00 %, 10.90 % respectively indicating that spiced swallow can be stored for longer period than other spiced powdered [11].The spiced form of all the powdered beans, okra, plantain had lower value than (13. 00 %) spices themselves. This can be attributed to the fact that the spices could have contained volatile oil in addition to incorporated water [12]. The unspiced Millet powder, Bean powder and Okra powder with the moisture contents of 9.22%, 7.06% and 7.23% are lower than the corresponding values for spiced foods samples which are 12.82%, 12.00%, 10.90% respectively. The increased values for spiced food might be the result of exposure during processing and mixing.

3.1.2 Protein Content

The protein content of the different spiced powdered studied in this work ranged from 14.17 % for spiced bean powder (SBP) to 2.19 % for spiced millet powder (SMP). The protein content (2.19 %) of spiced millet powder (SMP) is lower than the protein content (5.73 – 7. 43 %) of the spiced millet Ogi produced by different cereal blends which is in agreement with Eke-Ejiofor[13] who reported rating of the nutrient content and sensory properties of spiced ogi produced from different cereal blends. This could be as a result of the various spread of protein within various cereals as some cereal proteins can be distributed in the hulls, endosperm [14]. However in the case of spiced bean powder (SBP), the protein content of 14.18 % agreed with the result of processed black climbing (*P. Coccineus L.*) bean powder reported by [15]; 24.63% (Hepho bean), 20-27 %(common bean), 19-25 % (Lima bean), and 17-26 % (Pigeon bean). For spiced swallow (SS) which is a mixture of plantain and wheat, the protein content of 5.08 % agreed with 9.30 % reported by Ogunlakin and Abioye [15] for wheat-plantain flours and 2.45 % of spiced dried okra was lower than 11.59-17.25 % reported by Firmin *et al*. [16]. The difference in protein content may be the effect of using different drying methods on proximate composition [17]. Generally, there was a decrease in the value of protein contents of Millet and Okra after spicing. During certain processing method like extrusion, high temp and high pressure is applied to the foods which leads to the breakage of the peptide chain (strong and bind amino acids covalently) and denaturation causing decreased nutritive value of protein [18]

3.1.3 Fat Content

The fat content of this study, ranged from 0.13 % to 4.036 %. The fat content of spiced swallow (SW) was observed to be fairly low (0.13 %) which is fairly close to 1.5-1.93 % reported by Ogunlakin and Abioye,[15]. This shows that plantain-wheat powder contain low fat. For spiced bean powder (SPB), the fat content of 1.91 % which agreed with the result of processed black climbing (*P. Coccineus L.*) bean powder reported by Mosisa [19]. The result of 0.38 % fat for spiced powdered millet (SPM) was less than 3.52 % soaked millet powder reported by Preedy *et al* [20] but agreed with 0.87 % millet flour reported by Twinomuhwezi *et al*. [21]. The difference in results may be the influence of soaking on the nutritional value of millet [22]. The result of fat content of spiced dried powdered okra (SPO) revealed 4.36 % of spiced dried powdered okra (SPO), the value which is lower than *Agbagoma* (48.00 %) and *Balabi* (47. 80 %)reported by Ofori *et al*. [23]. This indicates that the variety has an influence on the fat content and the lower value observed as compared to literature may be due to the difference in variety and agroecological conditions of plant cultivation [23]. Fat plays a significant role in the shelf-life of food products and as such relatively high fat content could be undesirable in processed food products [24]. This is because fat can promote rancidity in foods, leading to development of unpleasant and odorous compounds [24]. The fat contents of bean powder and okra powder decrease from 7.88 and 19 for unspiced to 1.91 and 4.36 for the spiced.

3.1.4 Ash Content

The ash content obtained from this study ranged from 0.49 % to 16.16 %. The ash content (16.16 %) of spices (S) shows that spices (S) might be an important source of minerals than spiced powdered samples used in this work, though, researchers have shown that high ash content might also be due to adulteration [25]. Adulteration is the pollution of food products resulting from inorganic substances present in the food samples. The ash content (0.49 %) of spiced powdered millet agrees with the ash content (0.87 %) reported by Pikuda and Ilelaboye [20]. The result of (3.09 %) of spiced dried powdered okra (SDO) was lower than those reported by Ofori *et al*. [23], Agbagoma(7.70 %) and *Balabi* (7. 80 %). The difference could be due to the effect of using different drying methods on proximate composition ([17], variety and agro ecological conditions of plant cultivation [23]. The result of (1.99 %) of spiced bean powder (SBP) was less when compared with the ash content of 7.18 % Lima bean, 4.08 % Adzuki bean, 3.07 % African locust bean, 9.93 % Pigeon pea and 7.18 % white bean reported by Adamu *et al*. [26] and 3.09 % Christmas Lima beans, 5.01 % small red beans, 5.00 % red kidney beans, 3.01 % dehulled Christmas lima beans, 6.01 % dehulled small red beans and 5.49 % dehulled red kidney beans reported by Ibeabuch, *et al*. [10]. The difference could be due to the effect of using different drying methods on proximate composition [17].

3.1.5 Crude Fibre

The crude fibre content of the different spiced powdered samples analysed in this research were 6. 64 % spiced millet powder (SMP), 3.36 % spiced bean powder (SBP), 5.33 % spiced swallow (SSW), 6.22 % spiced dried okra (SDO). The result revealed that spiced millet powder (SMP) had the highest crude fibre content of 6.64 % than other spiced powdered samples used for this work. This indicates that spiced millet powder (SMP) can be more effective in keeping the digestive system clean and healthy, easing bowel movements, and flushing cholesterol and harmful carcinogens out of the body [27]. The fibre content of 2.0%, 4.0% and 2.2% for unspiced Millet powder, Bean powder and dried Okra powder are lower than the values obtained for the spiced version which is an indication of positive effect of spices on the fibre content of the food samples analysed.

3.1.6 Carbohydrates

The carbohydrate content of the different spiced powder ranged from 69.92 % to 87.72 %. This shows that spiced powdered are rich in carbohydrate. The carbohydrate content (87.72 %.) of spiced millet powder is not significantly different from the carbohydrate content (74.80-75.90 %) of defatted foxtail millet flour grown in china reported by Kumara *et al*. [28] and is also in agreement with 64.96 -72. 48 % of carbohydrate content of finger millet reported by Drewnowski *et al*. [29]. For the spiced beans powder (SBP), the carbohydrate content (69.92 %) is in line with 64.29-67.22 % black climbing bean flour reported by Mosisa, [19] and 75.94 – 86.64 % carbohydrate content of yam bean flour reported by Okoye and Ojobor, [30]. Considering the carbohydrate contents of unspiced food samples which are 70.82%, 64.86% and 39.72% for Millet, Bean and Okra respectively, one can say, there is significant increased in the value of carbohydrate content of spiced Food samples.

3.2 `Analysis of Metal Composition in Food Samples

3.2.1 Iron

Iron concentrations in five different spiced samples collected were analyzed and presented in Table 4.0 below. The iron content of spiced food samples consumed ranged between the lowest concentration, 11.62 mg/kg in spiced dried okra and the highest, 27.99 mg/kg in the raw spices as shown on Table 4.0. They were generally below the MPL (maximum permissible limit) of 300 mg/kg and don't pose a health threat. Adeola *et al* [31] reported iron concentrations in spices, ginger had the highest concentration, 1266 ± 140 mg/kg and garlic 115 ± 11 mg/kg the lowest, while Salihu and Umar [32] reported the concentration for curry, nutmeg and beef spicy to be 136, 39.3 and 29.0 mg/kg. The result for the non parametric test shows that the distribution of Fe in all the samples are not the same since the Krusakal-Wallis test for independent samples shows a significant difference in the concentration of Iron across the samples. Iron facilitates carbohydrate, protein and fat oxidation controlling body weight, an important factor in some diseases.

3.2.2 Magnesium

Magnesium was found in the concentration range from 26.29 to 82.18 mg/kg. The recorded highest concentration of 82.12 mg/kg magnesium is in the spices, followed by that in the spiced dried okra with a concentration of 39.30 mg/kg. Other samples were also significantly less than that of the permissible limit allowed by [33], which was reported as 400mg/kg. The result was compared with those analyzed spices, collected from South-eastern Nigeria Markets which were between 19.17 to 261 mg/kg [34][35], and were higher.

3.2.3 Zinc

The result obtained for Zinc in the spiced food samples as shown in Table 3.0 ranged between 4.20 and 20.45 mg/kg. All the samples were found to be significantly less than that of WHO permissible limit at 95% confidence interval.

Table 3.0: Metal composition of Blended Spices, Unspiced and Spiced food Samples Using ICP-AES

Samples	Fe (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Ca (mg/kg)	Mg (mg/kg)
Spiced Dried Okra	11.6221 ± 0.0004	9.4681 ± 0.0113	4.2166 ± 0.0170	82.5452 ± 0.0152	39.3079 ± 0.0215
Spices	27.9928 ± 0.0035	20.4515 ± 0.0119	18.7349 ± 02106	103.228 ± 0.1252	82.1872 ± 0.0161
Spiced Millet	10.2561 ± 0.02768	6.0288 ± 0.0091	1.7294 ± 0.0085	63.7928 ± 0.0070	31.0816 ± 0.0097
Swallow (Plantain and Wheat)	13.3481 ± 0.01480	11.6872 ± 0.0172	2.8217 ± 0.0134	45.966 ± 0.0120	26.2892 ± 0.0122
Spiced Beans	13.8811 ± 0.0098	4.2001 ± 0.0115	2.6682 ± 0.0120	57.3762 ± 0.0338	29.8027 ± 0.0386
Unspiced Millet	1.1811 ± 0.0003	0.5660 ± 0.0013	0.3320 ± 0.0049	149.3879 ± 5.9287	19.9775 ± 0.0034
Unspiced Bean powder	1.3398 ± 0.0023	0.6023 ± 0.0013	0.3439 ± 0.0002	30.9822 ± 0.9881	22.3684 ± 1.4509
Unspiced Dried Okro	7.5926 ± 0.0016	1.0297 ± 0.0012	0.4108 ± 0.0025	94.8829 ± 5.1567	22.9689 ± 0.9816
Unspiced Dried Pepper	8.3883 ± 0.0013	0.6268 ± 0.0020	0.3320 ± 0.0049	45.3139 ± 1.2662	22.9383 ± 1.2522
FAO/WHO permissible limit (2009)	300	50	2	200	400

Table 4.0 : Result for the Non-Parametric Test of the variety of spices samples

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Fe is the same across categories of factor.	Independent-Samples Kruskal-Wallis Test	.009	Reject the null hypothesis.
2	The distribution of Zn is the same across categories of factor.	Independent-Samples Kruskal-Wallis Test	.009	Reject the null hypothesis.
3	The distribution of Mn is the same across categories of factor.	Independent-Samples Kruskal-Wallis Test	.009	Reject the null hypothesis.
4	The distribution of Ca is the same across categories of factor.	Independent-Samples Kruskal-Wallis Test	.009	Reject the null hypothesis.
5	The distribution of Mg is the same across categories of factor.	Independent-Samples Kruskal-Wallis Test	.009	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Table 6.0: Analysis of variance of the selected Spicies and Unspiced food sample

Groups	*Count*	*Sum*	*Average*	*Variance*
Zn	10	6.0869	0.60869	0.047608
Fe	10	37.1739	3.71739	8.912998
Mg	10	225.2892	22.52892	1.834058
Mn	10	3.4259	0.34259	0.000611
Ca	10	724.4248	72.44248	1875.445

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	37841.43	4	9460.358	25.07728	5.81E-11	2.578739
Within Groups	16976.17	45	377.2481			
Total	54817.6	49				

Further analysis such as the non-parametric test presented in Table 4.0 agrees with the ANOVA result in Table 3.0 and confirms that although the concentrations of zinc in all the samples were significantly different from one another their distributions were also very different across the samples. These values are higher than the 0.01 to 0.63 mg/kg obtained by Ujowundu *et al* [35] in South eastern Nigeria and also higher than 1.11−2.57 mg/kg obtained by Kumaravel and Alagusundaram [34] in Indian spices. This is a positive factor because recent data indicate that the lack of this vital element is common in 48% of all global population [36].

3.2.4 Calcium

The calcium content in spices was the highest, ranging from 45.97-103.23 mg/kg (Table 3.0). The result was in agreement with the result obtained by Balny and Masson [37] and Ujowundu *et al*., [35]. Kumaravel and Alagusundaram [34] investigated the spices from the Indian market and detected Ca in the concentrations of 243.2−1353.0 mg/kg which is higher than the result obtained in this study.

3.2.5 Manganese

The mean levels of Manganese (mg/kg) in the samples (Table 3.0) ranged from 1.729 ±0.008 in spiced millet to 18.734 ±0.021 in spices. The FAO/WHO [33] permissible limit for Mn in plant was giving as 2mg/kg [38]. The amount of Mn in all the spiced samples were significantly higher than the permissible limit set by the World Health Organization [38]. The concentration in spices (S) is very high and could be toxic if consumed in large quantity. The result of the non-parametric test confirms the hypothesis of significant difference at 0.05 probability level of manganese across the samples.

Table 7.0: Pearson correlation analysis of some metal composition in the studied spiced Samples

		Fe	Zn	Mn	Ca	Mg
Fe	**Pearson Correlation**	**1**				
	Sig. (2-tailed)					
Zn	**Pearson Correlation**	**0.875****	**1**			
	Sig. (2-tailed)	**0.000**				
Mn	**Pearson Correlation**	**0.977****	**0.908****	**1**		
	Sig. (2-tailed)	**0.000**	**0.000**			
Ca	**Pearson Correlation**	**0.728****	**0.693****	**0.845****	**1**	
	Sig. (2-tailed)	**0.002**	**0.004**	**0.000**		
Mg	**Pearson Correlation**	**0.940****	**0.868****	**0.988****	**0.912****	**1**
	Sig. (2-tailed)	**0.000**	**0.000**	**0.000**	**0.000**	

****. Correlation is significant at the 0.01 level (2-tailed).**

Pearson correlation analysis results in Table 7.0 above shows that there is a significant positive correlation between all the metals at 99% confidence interval. The result presented in Table 4.4 shows that there is 97.7% correlation between Fe and Mn, and a 98.8% correlation between Mn and Mg. This shows that these metals are directly from the same source. Other notable ones include Fe and Mg (94%), Zn and Mn (90.8%), Ca and Mg (91.2%) respectively.

IV. CONCLUSION

The work revealed nutritional composition of spiced millet powder, spiced bean powder, spiced dried okra powder and spiced unripe plantains powder. The moisture contents were found to be low thus making them to have a longer shelf life and would be less susceptible to deterioration and spoilage due to the action of mold and other microorganism which thrives well at higher moisture contents. The proximate composition result of spiced millet powder, spiced bean powder, spiced dried okra powder and spiced unripe plantains powder showed that the spiced powder are good source of nutrients therefore has great potential in combating the malnutrition in developing countries. Therefore there represented a source of alternative nutrient supplement. Also, their nutritional compositions were found to be good thus making them a potential sources of quality nutritional materials for use in food industry.

V. RECOMMENDATION

As a result of the nutritional composition of the spiced millet powder, spiced bean powder, spiced dried okra powder and spiced unripe plantains powder revealed in this study, there would be good substitute for food supplements hence their production and consumption should be encouraged while research effort should continue for increase utility of their values.

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