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Proximate Analysis and Elemental Composition of Seasoned and Unseasoned Food Products from Bwari Area Council Abuja, Federal Capital Territory: A Study Using AOAC and ICP-AES Methods

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Abstract

This study was carried out to investigate the Proximate Analysis and Elemental Composition of some Seasoned and Unseasoned 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 elements were also determined using the Atomic Absorption spectrophotometric method and Inductive Coupled Plasma Atomic Emission Spectrometer (ICP AES). The moisture content, the protein content, the fat content, the ash content, the crude fibre, and Carbohydrate of all the analysed Seasoned samples ranged as follows; 7.5-12.00%, 2.19-14.7%, 0.13 -4.036 %, 0.49 – 16.16%, 3.36- 6.64%, 69.92 % - 87.72 % respectively. Also, the results of the elemental composition of the samples are as follows; 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 andless open to degeneration and spoilage by the action of mold and other microorganisms which flourish well at higher moisture contents. The protein and carbohydrate contents were relatively high compared to other food samples. The mineral and trace metal composition was within the acceptable standards required by the body. These food samples have enough nutritional value to contribute to our health and solve the problem of malnutrition in Nigeria.

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Introduction

Food is anything meant to give energy or nourishment to the body. It is any substance eaten by living organisms to provide nutrients to the body (Salmani *et al*, 2020). 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 (Bornhorst*et al*, 2016). Food can also be classified based on the types of nutrients it contains and its role in the body (Whitney and Rolfes, 2013). 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 hydrolysed by an organism to give energy and build tissue (Nekemte*et al*, 2015). Nutrients are again divided into three; plant nutrients, animal nutrients and plant and animal nutrients mixed. 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 nutrients..Nutrition is the science that explains the interplay of nutrients and other food components to the maintenance, growth, reproduction, health and disease of an organism. Food intake, absorption, assimilation, biosynthesis, catabolism and excretion are included in this study (Nekemte*et al*, 2015).

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 (Kouris-Blazos and Belski, 2016)

Nutrients are at the foundation of nourishment and Foods are to a large extent made up of five main nutrients; carbohydrates, proteins, fats, vitamins and minerals (Abolaji *et al*, 2019) Carbohydrates, proteins, and fats, major parts of our diet and Vitamins and Minerals are needed in little quantity. These two categories are regarded as macro and micronutrients respectively. However, water is considered a micronutrient because it does not contain energy (Whitney and Rolfes, 2013).The nutritional content of food varies depending on the mode of preparation (Bourdon*et al*, 2010). The correct intake of food promises an adequate supply of nourishment needs by the body.

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In developing country like Nigeria, malnutrition is common due to inability to afford nutritional food. An increasing gap exists between population explosion and nutritive food supply (Pennington and Fisher, 2010). Food composition data are important for estimating energy and nutrient intake but are scanty (Medina-Ramon *et al*, 2017)

This work will be conducted to evaluate nutritional properties or chemical composition and mineral composition of unseasoned and seasoned 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 and supplements have played a role in bridging the ever-increasing gap between population vital statistics and nutritional food supply (Bourdon*et al*, 2010; Pennington and Fisher, 2010).It will bring to light, nutritional values and expose the use of seasoned 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 unseasoned and Seasoned millet, beans, dried okra and unripe plantain powder, determination of nutritional properties or chemical compositions of unseasoned and seasoned millet, beans, dried okra and unripe plantain powder will rely on: measuring the moisture, protein, ash, fibre, fat, CHO, vitamin and minerals using proximate analysis technique.

Understanding the composition of food is crucial for both researchers, practitioners, scientists and nutritionists. Proximate analysis has been a staple in nutritional science for decades, providing essential data on the macronutrient content of various food items. The concept of proximate analysis dates back to the 19th century, pioneered by chemists like Carl Friedrich Mohr and Justus von Liebig. Over time, it has evolved with advancements in laboratory technology, but its fundamental principles remain the same. It plays a significant role in the food industry by providing critical insights into the nutritional value of food products. By determining the levels of moisture, ash, protein, fat, and carbohydrates, manufacturers can create accurate nutritional labels that inform consumers about the products they purchase. This transparency fosters trust and aids consumers in making healthier dietary choices. Moreover, this technique helps food producers tailor their products to meet market demands and regulatory standards, ensuring safety and quality. Importantly, this It also aids in research and development, allowing for the innovation of functional foods that align with current health trends and consumer preferences. Overall, the application of proximate analysis not only enhances consumer knowledge but also drives the continual advancement of the food industry. Estimating these parameters ensures the consistency and quality of food products through rigorous quality control measures to meets the nutritional labeling requirements set by health authorities, ensuring regulatory compliance. Overall, proximate analysis plays a pivotal role in bridging the gap between food production and consumer awareness.

Materials and Methods

Sampling and Samples Preparation

Samples of Millet, Unripe plantain, beans, and Okra that are commonly consumed around the study area were collected from Bwari Central Market, which is one of the busiest markets 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 and were subjected to proximate nutrient composition analysis and components analyzed were moisture, ash, protein, fat, crude fibre and carbohydrate. This was done using standard methods as described by the Association of Official Analytical Chemists (AOAC, 2005). ICP-AES Method was used to determine elemental composition of the food sample.

Determination of moisture

Platinum dish was washed, dried, cooled and weighed (W_1), afterward 2g 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. The Percentage amount of moisture resulting from the drying was calculated using the following formula;

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

W_1= Weight of sample with Petri dish before drying
W_2= Weight of sample with Petri dish after drying
W = Weight of sample

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^oC until it was

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fully ashed (colour changes to gray) and the weight (w_3) was recorded after cooling to room temperature. The ash content was calculated using the formula:

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

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. The 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 105ºC in an oven, cooled and weighed (w_2).

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

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. The 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 was transferred to the digestion flask. The anti-bump was again added and the distillation framework 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 in 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:

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

$$\text{\% protein} = \text{\% of Nitrogen} \times 6.24$$

Determination of Carbohydrate

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

$$\text{Carbohydrate (\%)} = 100 - [\text{Moisture} + \text{Ash} + \text{Fat Protein}] \quad 2.7$$

Determination of Crude fiber

Crude fiber was 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 boil 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 transferred 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 °C in the air and in an oven for about 2 hr. It was cooled to room temperature in a desiccator and weighed. The process was repeated for 30 minutes, drying, cooling and weighing until the difference between two successive weights was less than 1 mg. The lowest weight was considered as the weight of the crucible and contents after drying.

The contents in the crucible were incinerated in an electric muffle furnace at 620°C for about 30 minutes. It was cooled to room temperature in desiccators and weighed. The process was repeated until the difference between two successive weighs was 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.

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

W = Sample weight (g)

W_1= Crucible and contents weight after drying (g)

W_2= Crucible and ash weight after incinerating (g)

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

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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.

Mineral Composition and Trace Elements
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°C and up to 250-300 °C. 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).

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 to analyse 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 volumetricflask 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.

Results and Discussion

Results of the chemical composition of Unseasoned pure food samples and Seasoned food Samples

The chemical composition results of moisture, crude protein, fiber, ash, fat content and carbohydrate of some Unseasoned and Seasoned 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 Seasoned 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

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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 unSeasoned 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

Moisture

The Seasoned bean powder (SBP) had the highest moisture content of 12.00 % while Seasoned swallow (SS) had the lowest moisture content of 7.35 % (Table 4.1). This shows that, Seasoned swallow (SS) had the least number of water molecules incorporated into it. The low moisture content (7. 35 %) for Seasoned 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 (Ibeabuchi*et al*, 2017)). The moisture content (7.35 %) Seasoned swallow (SS) is lower when compared to the moisture content for Seasoned millet powder (SMP), Seasoned bean powder (SBP) and Seasoned okra powder (SOP) which are 9.22 %, 12. 00 %, 10.90 % respectively indicating that Seasoned swallow can be stored for longer period than other Seasoned powdered (Intipunya and Bhandari, 2010).The Seasoned form of all the powdered beans, okra, and plantain had a 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 (Fairbanks, 2007). The unseasoned Millet powder, Bean powder and Okra powder with moisture contents of 9.22%, 7.06% and 7.23% are lower than the corresponding values for Seasoned foods samples which are 12.82%, 12.00%, 10.90% respectively. The increased values for seasoned food might be the result of exposure during processing and mixing.

Protein Content

The protein content of the different Seasoned powders studied in this work ranged from 14.17 % for seasoned bean powder (SBP) to 2.19 % for seasoned millet powder (SMP). The protein content (2.19 %) of Seasoned millet powder (SMP) is lower than the protein content (5.73 – 7. 43 %) of the Seasoned millet Ogi produced by different cereal blends which is in agreement with Eke-Ejiofor(2018) who reported rating of the nutrient content and sensory properties of Seasoned ogi produced from different cereal blends. This could be a result of the various spread of protein within various cereals as some cereal proteins can be distributed in the hulls, endosperm (Welch, 2005). However in the case of Seasoned bean powder (SBP), the protein content of 14.18 % agreed with the result of processed black climbing (*P. Coccineus L.*) bean powder reported by Firmin *et al* (2018); 24.63% (Hepho bean), 20-27 %(common bean), 19-25 % (Lima bean), and 17-26 % (Pigeon bean). For Seasoned 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 (2014) for wheat-plantain flours and 2.45 % of Seasoned dried okra was lower than 11.59-17.25 % reported by Firmin *et al* (2018). The difference in protein content may be the effect of using different drying methods on proximate composition (Amoasah*et al*, 2018). 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

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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 (Butter, 2018)

Fat Content

The fat content of this study ranged from 0.13 % to 4.036 %. The fat content of Seasoned swallow (SW) was observed to be fairly low (0.13 %) which is fairly close to 1.5-1.93 % reported by Ogunlakin and Abioye (2014). This shows that plantain-wheat powder contains low fat. For Seasoned 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 (2016). The result of 0.38 % fat for seasoned powdered millet (SPM) was less than 3.52 % soaked millet powder reported by Preedy *et al*(2011) but agreed with 0.87 % millet flour reported by Twinomuhwezi *et al*. (2020) The difference in results may be the influence of soaking on the nutritional value of millet (Shanmugapriya and Nazni, 2020). The result of fat content of seasoned dried powdered okra (SPO) revealed 4.36 % of seasoned dried powdered okra (SPO), the value which is lower than *Agbagoma* (48.00 %) and *Balabi* (47. 80 %)reported by Ofori *et al* (2020) 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 (Ofori *et al*, 2020). 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 (Carroll*et al*, 2020). This is because fat can promote rancidity in foods, leading to development of unpleasant and odorous compounds (Carroll*et al*, 2020). The fat contents of bean powder and okra powder decrease from 7.88 and 19 for unSeasoned to 1.91 and 4.36 for the Seasoned.

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 seasoned powdered samples used in this work, though, researchers have shown that high ash content might also be due to adulteration (Jibrin*et al*, 2022). Adulteration is the pollution of food products resulting from inorganic substances present in the food samples. The ash content (0.49 %) of Seasoned powdered millet agrees with the ash content (0.87 %) reported by Pikuda and Preedy *et al* (2020). The result of (3.09 %) of seasoned dried powdered okra (SDO) was lower than those reported by Ofori *et al*. (2020), 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 agroecological conditions of plant cultivation (Ofori *et al*, 2020). The result of (1.99 %) of Seasoned 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 Chen*et al* (2019) 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*. (2017). The difference could be due to the effect of using different drying methods on proximate composition (Amoasah*et al*, 2018).

Crude Fibre

The crude fibre content of the different Seasoned powdered samples analysed in this research were 6. 64 % Seasoned millet powder (SMP), 3.36 % Seasoned bean powder (SBP), 5.33 % Seasoned swallow (SSW), 6.22 % Seasoned dried okra (SDO). The result revealed that Seasoned millet powder (SMP) had the highest crude fibre content of 6.64 % compared to other Seasoned powdered samples used for this work. This indicates that Seasoned 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 (Anderson and Bridges, 2008). The fibre content of 2.0%, 4.0% and 2.2% for unseasoned Millet powder, Bean powder and dried Okra powder are lower than the values obtained for the seasoned version which is an indication of a positive effect of spices on the fibre content of the food samples analysed.

Carbohydrates

The carbohydrate content of the different seasoned powder ranged from 69.92 % to 87.72 %. This shows that seasoned powdered are rich in carbohydrate. The carbohydrate content (87.72 %.) of Seasoned 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*. (2009) and is also in agreement with 64.96 -72. 48 % of carbohydrate content of finger millet reported by Drewnowski *et al*(2013) For the Seasoned beans powder (SBP), the carbohydrate content (69.92 %) is in line with 64.29-67.22 % black climbing bean flour reported by Mosisa(2016) and 75.94 – 86.64 % carbohydrate content of yam bean flour reported by Okoye and Ojobor(2016). Considering the carbohydrate contents of unseasoned food samples which are 70.82%, 64.86% and 39.72% for Millet, Bean and Okra respectively, one can say, there is a

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significant increase in the value of carbohydrate content of Seasoned Food samples.

Analysis of Metal Composition in Food Samples

Iron

Iron concentrations in five different seasoned samples collected were analyzed and presented in Table 4.0 below. The iron content of Seasoned food samples consumed ranged between the lowest concentration, 11.62 mg/kg in Seasoned dried okra and the highest, 27.99 mg/kg in the raw spices as shown in 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*(2020) 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 (2014) reported the concentration for curry, nutmeg and beef spicy to be 136, 39.3 and 29.0 mg/kg. Iron facilitates carbohydrate, protein and fat oxidation controlling body weight, an important factor in some diseases.

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 Seasoned dried okra with a concentration of 39.30 mg/kg. Other samples were also significantly less than that of the permissible limit allowed by] FAO/WHO (2002), 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 (Kumaraveand Alagusundaram, 2014; Ujowundu*et al*, 2011), and were higher.

Zinc

The result obtained for Zinc in the seasoned 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 WHO permissible limit at 95% confidence interval.

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

Samples	Fe (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Ca (mg/kg)	Mg (mg/kg)
Seasoned 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
Seasoned 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
Seasoned Beans	13.8811 ± 0.0098	4.2001 ± 0.0115	2.6682 ± 0.0120	57.3762 ± 0.0338	29.8027 ± 0.0386
Unseasoned Millet	1.1811 ± 0.0003	0.5660 ± 0.0013	0.3320 ± 0.0049	149.3879 ± 5.9287	19.9775 ± 0.0034
Unseasoned Bean powder	1.3398 ± 0.0023	0.6023 ± 0.0013	0.3439 ± 0.0002	30.9822 ± 0.9881	22.3684 ± 1.4509
Unseasoned Dried Okro	7.5926 ± 0.0016	1.0297 ± 0.0012	0.4108 ± 0.0025	94.8829 ± 5.1567	22.9689 ± 0.9816
Unseasoned 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

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Table 4.0: Analysis of variance of the selected Spices and Unseasoned 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				

The ANOVA result in Table 4.0 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* (2011) in Southeastern Nigeria and also higher than 1.11−2.57 mg/kg obtained by Kumaravel and Alagusundaram (2014) 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 (Oteiza and Mackenzie, 2005)

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 (2009) and Ujowundu *et al*., (2011). Kumaravel and Alagusundaram (2014) 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.

Manganese

The mean levels of Manganese (mg/kg) in the samples (Table 3.0) ranged from 1.729 ±0.008 in seasoned millet to 18.734 ±0.021 in spices. The FAO/WHO permissible limit for Mn in plant was giving as 2mg/kg (WHO/FAO, 2010). The amount of Mn in all the seasoned samples was significantly higher than the permissible limit set by the World Health Organization (WHO/FAO, 2010).The concentration in spices (S) is very high and could be toxic if consumed in large quantity.

Table 5.0: Pearson correlation analysis of some metal composition in the studied Seasoned 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			

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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 show 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 a 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.

Conclusion

The work revealed the nutritional composition of seasoned millet powder, seasoned bean powder, seasoned dried okra powder and seasoned unripe plantain 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 microorganisms which thrive well at higher moisture contents. The proximate composition result of seasoned millet powder, seasoned bean powder, seasoned dried okra powder and seasoned unripe plantains powder showed that the seasoned powder is good source of nutrients therefore has great potential in combating malnutrition in developing countries. Therefore, there represented a source of alternative nutrient supplements. Also, their nutritional compositions were found to be good thus making them a potential sources of quality nutritional materials for use in food industry.

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