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ASSESSMENT OF NUTRITIONAL CHEMICALS AND ANTIOXIDANT ACTIVITIES OF SOME FOOD COMPONENTS FOR THEIR POTENTIAL AS FUNCTIONAL FOODS AND PREBIOTICS

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ABSTRACT

Functional foods are known to contain some nutritional chemicals and/or possess antioxidant properties. Therefore, this study was aimed at assessing the nutritional chemicals and antioxidant activities of date, walnut, cashew nut and bush mango seeds for their potential as functional foods. Proximate, mineral, phytochemical, anti-nutritional, antioxidant and amino acid compositions of the food samples were investigated using standard methods. The moisture content observed in the four functional foods was highest in cashew nut with a percentage value of 6.25% and lowest in walnut (4.33%). Also, cashew nut had the highest amount of protein, with a value of 28.55%. Fat ranged from 0.98 – 1.78%; There was a noticeable high amount of total carbohydrate as its value ranged from 42.45 – 56.55%. Proximate analysis also revealed low ash contents. Mineral analysis revealed the presence of magnesium, calcium, potassium, nitrogen, sodium and phosphorus. Date had the highest amount of potassium (2.67%) whereas walnut had the highest amount of phosphorus (1.22%). Energy contribution from protein ranged from 12.21 – 16.37% while that of fat ranged from 1.69 – 2.86%. Anti-nutritional analysis showed the presence of oxalate, phytic acid, tannin and cyanide. Several phytochemicals like saponin, alkaloid, flavonoid and steroid were detected in all the samples. Essential amino acids were present in the samples in varied concentrations. Concentration of glutamic acid was highest in walnut (13.02 g/100g) followed by cashew nut (12.87 g/100g). All the samples showed antioxidant activities which was significant. This study has revealed that date, walnut, cashew nut and bush mango seed possess potential as functional foods which provide a wide range of essential nutrients and antioxidant properties with many potential health benefits.

Keywords: Antioxidant, functional foods, nutrition, phytochemical.

INTRODUCTION

Nutrition plays an important role in the health and development of an individual (Hussain *et al*., 2010). The adequate nutritional needs of an individual ensure tissue renewal, beneficial microorganism development (prebiotics) and maintenance of good physical and mental health (Bello *et al*., 2008). Hence, plant-based and animal-based foods offer an array of nutrients that are essential for human nutrition and promote good health (Hussain *et al*., 2010). The relationship between nutrition, dietary probiotics and prebiotics and health is an active area of research; however, a substantial body of evidence already indicates that food components can influence physiological and metabolic processes (Liu *et al.*, 2009). According to WHO (2003) and International Scientific Association for Probiotics and Prebiotics (ISAPP 2016), the most essential food produced by plants are carbohydrates, fats and proteins, each being of value in its own to human metabolism and development. However, there are also animal mineral salts, organic acids, vitamins and enzymes that are required for general health. Dietary intakes not meeting the essential needs of the body are the primary cause of malnutrition.

Malnutrition could be as a result of inadequate or imbalanced diet which does not contain all the nutrients needed for good nutritional status (Thomas, 2005). Thus, functional foods and prebiotics are of increasing interest in the management, prevention and/or treatment of diet-related diseases (Omueti *et al*., 2009). However, for much of the world's population, functional foods are used to simply provide essential nutrients (Liu *et al.*, 2009) while prebiotics are used essential food compound that foster growth and development of beneficial microbes in the gastrointestinal tract (GIT) (Satokari *et al.*, 2009, Laureys *et al.*, 2016 and Umar *et al.*, 2021). Hence, some nutrients are required in large amounts, but others such as iron (Fe), zinc (Zn), copper (Cu), iodine (I), and selenium (Se), are required in trace amounts because higher levels could be harmful (Hussain *et al*., 2010). Because each food has a different nutritional profile, the dietary insufficiency of one or more macro and micronutrients remains a concern in populations that do not have a balanced diet. This kind of malnutrition has been significantly alleviated in some countries as a result of programs that fortify processed foods through dietary assessment (FAO, 2003). Improving nutrition contributes to productivity, economic development, and poverty reduction by improving physical work capacity, cognitive development, school performance, and health by reducing diseases and mortality (Aletor *et al*., 2007).

Accurate dietary assessment is the foundation for determining nutritional status in individuals for clinical practice and in the population for public health. Proper dietary assessment depends on the accurate food composition data (Hussain *et al*., 2010). Food composition databases are essential tools for dieticians and other health professionals. Also, they are used to evaluate the dietary adequacy of meals and diets and to identify relationships between diet, health, and diseases according to the results of national, clinical, and epidemiologic studies (Omueti *et al*., 2009). Food composition databases must be constantly updated with information on nutrient profiles of foods. To avoid mistaken decisions or interpretations, food composition databases must be a high quality, reliable, up-to-date food composition databases and representative of the food consumed by the population (Hussain *et al*., 2010). By identifying the nutrients present in foods, duly informed individuals have the necessary autonomy, liberty, and knowledge to make suitable food choices (Liu *et al.*, 2009).

In Nigeria, a high proportion of the rural and urban population resort to natural food used as soup and medicine, particularly because of their availability. Lack of attention about food consumed by populace has meant that their potential nutritional values are underestimated. It places them in danger of

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continued genetic erosion and extinction which would restrict development options (Whitney and Rolfes, 2005). Many of these natural foods contain phytochemicals, which are health-promoting and disease-preventing (Rehman *et al*., 2012). Both epidemiological and clinical studies have proven that phytochemicals present in cereals, fruits and vegetables are mainly responsible for reduced incidence of chronic and degenerative diseases among populations whose diets are high in these foods (Whitney and Rolfes, 2005). As a result, there has been an increased search for phytochemical constituents that possess antioxidant and antimicrobial potency in recent time (Liu *et al.*, 2009). Typical phytochemicals with antioxidant and antimicrobial activities include polyphenols, phenolic acids and their derivatives, flavonoids, phospholipids, ascorbic acid, carotenoids and sterols.

Cereals, fruits and nuts, vegetables, root and tuber crops, spices, meat and fishes are commonly consumed by both rural and urban dwellers in Nigeria (Rehman *et al*., 2012). They play significant roles in human nutrition, especially as sources of carbohydrates, proteins, vitamins, minerals, and dietary fibre (Hussain *et al*., 2010). Most of these foods are functional and few are prebiotics as their constituents are essential for normal physiological well-being and help in maintaining healthy state through development of resistance against pathogens. Seeds and nuts are of special nutritional importance (Whitney and Rolfes, 2005) because of their high nutritional components due to high quality content of essential amino acids (Rehman *et al*., 2012). Functional food and prebiotics remains an important source of nutrients for human and animal consumption in many parts of the world, and offer advantages over dietary supplements because of low cost and wide availability. Therefore, the main aim of this study is to assess the nutritional chemicals and antioxidant activities of some food components for their potential as functional foods and prebiotics.

MATERIALS AND METHODS

Description of Study Site

The study was conducted within Kaduna Metropolis, Kaduna State. The state has a total land mass of 48473.25Km^2 and is located West Geographical Zone of Nigeria. It lies between longitude 6° and 9° E and latitude 9° and 11° N. The state has a distinct Wet Season (April –October) and Dry Season November-March), Vegetation type is the Guinea Savannah (Umar *et al.,* 2021).

Sample Collection

Fresh matured date, walnut, cashew nut and bush mango seed were purchased from the Checheniya Market, Kaduna, and were taken to the Department of Botany, Ahmadu Bello University Zaria for proper identification and botanical authentication ({Date: 1911, Walnut: 1909, Cashew nut: 1908 and Bush mango: 1910}, Orji *et al.,* 2023).

Sample Preparation

The samples were oven-dried and cleaned to discard unwanted particles such as stalks, stones, and immature seeds. The samples were then milled using a grinding mill. The milled samples were subsequently package in Ziploc bags and labeled adequately for further use.

Proximate Analysis

Proximate analysis of the samples to determine the moisture content, total ash, crude fat an crude protein, were carried out using Aritra and Sumana (2012) methods and Bakare *et al.* (2020) with slight modifications Ramzija *et al.,* 2022.

Mineral Analysis

The mineral content of the samples was determined using the methods of the AOAC methods (Muhammad *et al*., 2011). About 1.0 g of sample was first digested with 20 ml of acid mixture (650 ml Conc. HNO_3, 80 ml Perchloric acid, 20 ml H_2SO_4) by weighing the sample into a digestion flask followed by addition of the 20 ml acid mixture. Aliquots

of the clear digest were used for atomic absorption spectrophotometry using filters that matched the different elements. The concentration of calcium, magnesium, sodium and potassium were determined with their calibration curves prepared with their standard solutions. Phosphorus and nitrogen contents were also determined using the methods described by Muhammad *et al*. (2011).

Energy Content

The calorific energy value was obtained according to the methods of Akinyeye *et al*. (2011). This was done by multiplying the value of carbohydrate, protein and crude fat by the Atwater factors of 17, 17 and 37 respectively.

Determination of Anti-nutritional Composition

- *Oxalate Determination*

The titration method as described by Muhammad *et al*. (2011) was adopted. About 0.5g of sample was weighed into 100ml conical flask. Then, 15mL 3M H_2SO_4 was added and stirred for one hour with a magnetic stirrer. It was filtered using Whitman filter paper. About 5ml of the filtrate was taken and titrated while hot against 0.05M $KMnO_4$ solution until a faint pink colour persist for at least 30 seconds. The Oxalate content was then calculated by taken 1ml of 0.05M $KMnO_4$ as equivalent to 2.2mg Oxalate.

- *Phytic Acid Determination*

Titrimetric method as described by Muhammad *et al*. (2011) was adopted. About 2g of the sample was soak in 100ml 2% of HCL for 3hours and then filtered. Twenty-five millilitres (25ml) of the filtrate was placed in a 100mL conical flask and 5ml of 0.03% of NH_4SCN solution was added as indicator. It was titrated with ferric chloride solution containing 0.005mg of Fe/mL of $FeCl_3$ used, until a brownish yellow persists for 5min. Phytic phosphorous (Pp) was determined and the phytic acid content was calculated by multiplying the value of Pp by 3.55.

- *Tannin Determination*

The method described by Muhammad *et al*. (2011) was used for the determination of tannin content in the sample. Finely ground sample of about 0.5g was defatted with 5ml Petroleum ether for 15minutes. The tannin in the defatted sample was then extracted with methanol and the absorbance at 760nm was measured in a spectrophotometer.

- *Cyanide Determination*

Determination of hydrogen cyanide was carried out using alkaline titration method (Muhammad *et al*., 2011). Five grams (5g) of ground sample was soaked in a mixture of $100cm^3$ of distilled water and 5ml of orthophosphoric acid. The mixture was left for 12 hours to release all bound hydrogen acid. Then, $40cm^3$ of 6.0M ammonium hydroxide (NH_4OH) and $1cm^3$ of 5% (w/v) potassium iodide (KI) solution was added. The mixture was titrated with 0.02M silver nitrate solution using a micro burette until a faint but permanent turbidity is obtained.

Phytochemical Screening

Phytochemical screening of the powdered seeds was carried out by a procedure reported by Rijke *et al.* (2006) to detect the presence of saponins, tannins, alkaloids, flavonoids, triterpenoids, steroids, glycosides, anthraquinones, coumarin, saponins, reducing sugars in the selected functional foods (Orji *et al.*, 2023).

Determination of Amino Acid Profile

The Amino Acid profile in the known sample was determined using methods described by Akinyeye *et al*. (2011). The known sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and loaded into the Applied Biosystems PTH Amino Acid Analyzer.

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Antioxidant Activity

- *Determination of DPPH Radical Scavenging Activity*

Radical scavenging activity of each concentrate against the 1, 1-diphenyl-1-picryl-hydrazyl radical (DPPH) was done according to the method described by Jayasri *et al.* (2009). Different concentrations of each sample extract were prepared in methanol and used for the assay at concentrations of 0.5, 1.0, 1.5 and 2.0 mg/ml. Ascorbic acid was used as standard, and the same concentrations as the test solution in methanol were prepared. Two milliliters of the prepared concentration were placed into test tubes and 0.5 mL of 1 mmol/L DPPH solution in methanol was added. The experiment was carried out in triplicates. The test tubes were incubated for 15 min at room temperature, and the absorbance was read at 517 nm. A blank solution containing the same amount of methanol and DPPH was prepared and the absorbance was read. Lower absorbance of the reaction mixture indicates higher free radical scavenging activity.

The radical scavenging activity was calculated using the following formula:

DPPH Radical Scavenging Activity (%) = $\frac{A0-A1}{A0} \times 100$

Where *A*0 is the absorbance of the blank (DPPH radical + methanol)

*A*1 is the absorbance of DPPH radical + sample or standard.

The 50% inhibitory concentration value (IC50) is indicated as the effective concentration of the sample that is required to scavenge 50% of the DPPH free radical.

- *Ferric-Reducing Antioxidant Power Assay*

The method described by Aletor *et al.* (2007) was employed for the assay. Each sample extract as well as ascorbic acid (standard) were prepared to a concentration of 100mg/mL. One milliliter of ferric-reducing antioxidant power reagent (200 mL of 300 mmol/L sodium acetate buffer at pH 3.6, 20 mL of 10.0 mmol/L 2,4,6-tripyridyl-s-triazine solution, 20 mL of 20.0 mmol/L $FeCl_3.6H_2O$ solution, and 24 mL of distilled water) was then added to each test tube. The resulting mixture was vigorously shaken and then incubated at 37°C for 4 minutes. The absorbance at 593 nm was measured and compared with the standard ascorbic acid.

Statistical Analyses

All data were analyzed using Microsoft Excel and SAS software version 9. The results were presented in tables.

RESULTS

Proximate Composition

The result of the proximate composition observed among the functional foods is shown in Table 1. The moisture content observed in the four functional foods was highest in cashew nut with a percentage value of 6.25% and lowest in walnut (4.33%). On the other hand, since dry matter is estimated by subtracting the moisture content value from 100, walnut had the highest dry matter, with a value of 95.67%. The total ash for the four functional foods was low, ranging from 1.00 – 1.45%. There was a relatively moderate amount of protein present in the food samples. Cashew nut had the highest amount of protein, with a value of 28.55%. Fat was present and it ranged from 0.98 – 1.78%. Also, the crude fibre content was small in all the four functional foods, occurring highest in date (2.10%) and lowest in walnut (1.00%). There was a noticeable high amount of total carbohydrate when compared with other proximate composition.

Table 1: Proximate Composition of the Functional Food Samples (%)

Sample	Moisture	Total Ash	Protein	Fat	Crude Fibre	Total Carbohydrate
Date	5.46	1.00	17.59	1.55	2.10	45.00
Walnut	4.33	1.45	19.55	1.78	1.00	56.55
Cashew nut	6.25	1.12	28.55	1.22	1.18	42.45
Bush Mango Seed	5.92	1.00	17.09	0.98	1.45	50.00

Mineral Composition of the Functional Foods

The mineral composition of date, walnut, cashew nut and bush mango seed as presented in Table 2, showed that nitrogen content is comparatively higher than other minerals; nitrogen is highest in walnut, having a value of 5.98%. Among the minerals, calcium had the least values ranging from 0.11 – 0.44%. Magnesium content ranged from 0.99 – 1.54% while that of sodium ranged from 1.56 – 2.41%. Date had the highest amount of potassium (2.67%) whereas walnut had the highest amount of phosphorus (1.22%).

Table 2: Mineral Composition of the Functional Foods Samples (%)

Sample	Ca	Mg	Na	K	P
Date	0.32	1.01	1.56	2.67	1.13
Walnut	0.23	1.00	2.41	1.32	1.22
Cashew nut	0.44	1.54	1.98	1.33	1.20
Bush Mango Seed	0.11	0.99	1.75	1.00	0.56

Energy Content

Date, walnut, cashew nut and bush mango seed have energy content of 188.4, 297.2, 322.3 and 263.7 kJ/100g respectively (Table 3). In all the four functional foods, carbohydrate had the highest percentage energy contribution when compared to protein and fat. Energy contribution from protein ranged from 12.21 – 16.37% while that of fat ranged from 1.69 – 2.86%.

Table 3: Energy Content and Contribution of the Food Samples

	Energy Content		Energy Contribution (%)		
Food sample	kcal/100g	kJ/100g	Carbohydrate	Protein	Fat
Date	45	188.4	83.12	14.02	2.86
Walnut	71	297.2	83.31	14.09	2.60
Cashew	77	322.3	81.29	16.37	2.34
Bush Mango Seed	63	263.7	86.10	12.21	1.69

Anti-nutritional Composition of the Functional Foods

The anti-nutritional composition of date as presented in Table 4 showed that it contained oxalate (3.52 mg/100g), phytic acid (15.90 mg/100g), tannin (4.71 mg/100g) and cyanide (0.45 mg/100g). Bush mango seed had the highest concentration of oxalate (4.50 mg/100g) and phytic acid (18.16 mg/100g). The highest amount of tannin was observed in date, having a concentration of 4.71 mg/100g. Cyanide was highest in walnut and lowest in cashew nut, with concentration of 1.25 mg/100g and 0.41 mg/100g respectively.

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Table 4: Anti-nutritional Composition of the Functional Food Samples (mg/100g)

Food sample	Oxalate	Phytic Acid	Tannin	Cyanide
Date	3.52	15.90	4.71	0.45
Walnut	1.46	17.00	1.11	1.25
Cashew nut	2.36	13.42	7.95	0.41
Bush Mango Seed	4.50	18.16	3.60	0.66

Phytochemical Screening of the Food Samples

A total of 13 phytochemicals were screened and detected in the selected functional foods (Table 5). Alkaloids, flavonoids and reducing sugar were detected in high amount in date. High concentration of steroids was detected in walnut. Also, high amount of tannins, cardiac glycosides, phenolics and reducing sugar were detected in cashew nut. Bush mango seed had high amount of tannins. Anthraquinones was slightly detected in walnut but not detected in other samples. Combined anthraquinones was not detected in cashew nut and bush mango seed.

Table 5: Phytochemical Screening of the Food Samples

Phytochemicals	Date	Walnut	Cashew nut	Bush Mango Seed
Tannins	++	+	+++	+++
Saponins	+	++	++	++
Steroids	+	+++	++	++
Alkaloids	+++	+	++	++
Cardiac Glycosides	++	+	+++	+
Anthraquinones	-	+	-	-
Combined Anthraquinones	+	+	-	-
Flavonoids	+++	++	++	++
Terpenoids	++	+	+	++
Phlobatatannins	+	+	++	+
Carotenoids	++	++	++	+
Phenolics	+	+	+++	++
Reducing Sugar	+++	++	+++	++

-Not detected; + slightly detected; ++ moderately detected; +++ high amount

Amino Acid Composition of the Food Samples

The amino acid composition as shown in Table 6 revealed that the concentration of glutamic acid was highest in walnut (13.02 g/100g) and cashew nut (12.87 g/100g). Walnut also had the highest amount of leucine (7.70 g/100g), isoleucine (3.93 g/100g), phenylalanine (4.26 g/100g), valine (4.6 g/100g), arginine (12.56 g/100g) and serine (4.21 g/100g). Bush mango seed had the highest amount of lysine (4.03 g/100g), methionine (1.39 g/100g) and tryptophan (1.26 g/100g). Date had the highest amount of norleucine (0.98 g/100g). Cashew nut had the highest amount of proline (2.64 g/100g), glycine (4.51 g/100g), threonine (3.66 g/100g) and aspartic acid (8.87 g/100g). Walnut and cashew nut had equal proportion of tyrosine (2.58 g/100g) and histidine (1.98 g/100g).

Table 6. Amino Acid Composition of Food Samples

Amino acid	Date (g/100g Protein)	Walnut (g/100g Protein)	Cashew nut (g/100g Protein)	Bush Mango Seed (g/100g)
Leucine	4.26	7.70	6.89	7.30
Lysine	3.13	1.64	4.03	5.73
Isoleucine	2.49	3.93	2.88	3.21
Phenylalanine	2.84	4.26	3.55	2.13
Norleucine	0.98	0.77	0.42	0.56
Tryptophan	0.04	1.00	1.26	1.42
Valine	3.62	4.68	4.62	3.27
Methionine	0.80	1.33	1.33	1.39
Proline	2.03	2.44	2.64	2.33
Arginine	2.41	12.56	9.63	6.54
Tyrosine	0.86	2.58	2.58	1.72
Histidine	0.83	1.98	1.98	1.85
Cystine	1.94	0.48	0.85	1.82
Alanine	3.03	2.73	3.26	3.56
Glutamic acid	5.15	13.02	12.87	1.73
Glycine	1.04	3.09	4.51	3.61
Threonine	2.94	2.77	3.66	2.39
Serine	2.32	4.21	1.78	3.19
Aspartic acid	3.35	5.83	8.87	6.70

Antioxidant Activity of the Food Samples

The antioxidant power of the functional foods shown in Table 7 revealed that Bush Mango seed was the most effective in antioxidant activity, which showed more than 50% scavenging activity of the DPPH free radical at the concentration of 0.5, 1.0, 1.5, 2.0 mg/ml. The 50% inhibitory concentration value is indicated as the effective concentration of the sample that is required to scavenge 50% of the DPPH free radical. The percentage scavenging activities of DPPH by other functional foods were not up to 50%. Date had the highest ferric-reducing power (367.50 μmol/L) among the function foods, followed by cashew nut (202.60 μmol/L), walnut (173.45 μmol/L) and then bushes mango seed (145.08 μmol/L) (Table 8).

Table 7: DPPH Radical Scavenging Activity of the Function Foods

	% Inhibition			
Samples	0.5 mg/ml	1.0 mg/ml	1.5 mg/ml	2.0 mg/ml
Ascorbic Acid (Standard)	11.2	20.0	23.6	28.9
Date	15.5	31.1	31.4	26.5
Walnut	7.0	14.4	10.7	23.0
Cashew nut	17.7	18.2	15.3	19.9
Bush Mango Seed	50.7	62.9	71.0	80.0

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Table 8: Ferric-reducing Antioxidant Power of the Food Samples

Samples	Ferric-reducing Antioxidant Power Value [μmol/L Fe(II)/g]
Ascorbic Acid (Standard)	309.55
Date	367.50
Walnut	173.45
Cashew nut	202.60
Bush Mango Seed	145.08

DISCUSSION

Carbohydrates are important constituents of date, cashew nut, walnut and bush mango seed, making them rich sources of energy for the human system (Khan *et al.,* 2008). Variation in the carbohydrate concentration of the food sample studied can be attributed to the nature of the plants and growing environment (Akinyeye *et al*., 2011). In contrast to the findings of this study, Borchani *et al*. (2010) analyzed the main chemical components of date and found that they were richer in carbohydrate (85%) than that of studied sample. The finding of this study is in agreement with the work of Ali *et al*. (2009) who found that the total carbohydrate concentration of date ranged from 45 – 60%. In this study, the value of 42.45 – 56.55% for total carbohydrate shows that the studied food samples are useful for providing the energy for metabolic processes. Carbohydrates provide the necessary calories in the diets of most people of the world.

Date, walnut, cashew nut and bush mango seed can be considered as good sources of dietary fibre such as cellulose, hemicellulose, lignin, pectin (Habib and Ibrahim, 2011). The crude fibre contents obtained in this study for all the food samples are lower than 4.34%, 4.00% and 9.4% reported by Ogungbenle (2011), Rehman *et al.* (2012) and Gamal *et al*. (2012), for date, walnut, and cashew nut respectively. Fibre content of foods also helps in digestion process and prevention of cancer (Ogungbenle, 2011). Low value of moisture content showed that dates can be stored for a long period of time without spoilage and it will not be susceptible to microbial growth (Oloyede, 2005). The low moisture content as observed in the samples is an evidence that these food samples may not be more inclined to decay, since nourishments with high dampness substance are more inclined to perishability (Cust *et al.,* 2009). This outcome is not shocking in perspective of the way that the sellers of these food samples assert to the truth, that they can be put away for a year or more especially for dates

The crude protein content of cashew nut is higher than that recorded for protein-rich foods including cowpea seeds (24.7%), lentil (26. 1%), *Mucuna flagellipes* (24. 9%), green pea (24.9%) and *Parkia biblobosa* (20. 9%) (Iqbal *et al*., 2006). It is however, comparable with values obtained for soya beans (30%) (Amoo *et al*., 2006). Consumption of 100g of cashew nut, date, bush mango seed and walnut may be capable of providing 17.09 - 28.55g of protein which satisfies recommended daily allowance of protein for children as well as adults (Vayalil, 2012). The sense of satiety experienced after eating date, walnut, cashew nut and bush mango seed might be attributed to their relatively high caloric value computed from its protein, fat and carbohydrate contents. Due to high values for fats and gross energy, this food promises a good nutritive supplementary source for human beings. Low ash contents in studied samples indicate that the total inorganic mineral is low (Oloyede, 2005). Oloyede (2005) stated that ash content is an index to evaluate and grade the nutritive

quality of foods. The samples have low ash content when compared to the result (3.27%) obtained by Ogungbenle (2011). This result is similar to 1.6% ash content reported by Gamal *et al*. (2012). This result is also in agreement with the result obtained from the analysis of different varieties of date (Faqir *et al.*, 2012).

From this study, date, cashew nut, walnut and bush mango seed can supply approximately 3% of the Dietary Reference Intakes (DRI) for potassium. Potassium is vital to cellular integrity and fluid balance as it plays an important role in nerve function. It also helps to metabolize proteins and carbohydrates in energy production, and regulates heart beat (Ekop, 2007). The results of the elemental mineral determination indicated the presence of sodium, potassium, calcium, magnesium, nitrogen and phosphorus in all the samples; their presence in the samples cannot be underrated because of their role in health and nutrition. The presence of Ca, Na, Mg, K and P in the food samples indicates their nutritional value. These minerals are important in maintaining the blood pH (Gamal *et al*., 2012). Ekop (2007) reported that calcium is important in blood clotting, muscle contraction and in certain enzymes in metabolic processes and was found to be present at appreciable levels.

The nutritional importance of a given food depends on the nutrients and anti-nutritional constituents of the food (Aletor *et al*., 2007). Low values of oxalate contents in the food samples enhance the edibility of these food materials which would be advantageous for the consumers. The low value of 1.46 – 4.50% oxalate in the samples is evidence that utilization of date, walnut, cashew nut and bush mango seed might not have any negative impact. Oxalate has been accounted to have negative impact on accessibility of mineral which will prompt assimilation of fundamental minerals in body particularly calcium by framing insoluble salts (Faqir *et al*., 2012). Oxalates are harmful for human beings as they can complex with most essential trace metals therefore making them unavailable for enzymatic activities and other metabolic processes (Ekop, 2007).

The concentrations of phytic acid in the studied food samples is within the WHO permissible limit of 48.50 mg/100g as recommended by World Health Organization (WHO, 2003). The low value of tannin implies that eating date, walnut, cashew nut and bush mango seed may not lower the availability of protein in the body as caused by excess tannin, saponin and phytate in human body (Aletor *et al*., 2007). This suggests that these food samples are safe for consumption. The food samples contain very low cyanide which indicates that the samples will not cause any effect as regard to cyanide. Therefore, these foods can be eaten effectively since the anti-nutritional composition is low and there would be no interference with the nutrients like protein and minerals in the body. The presence of alkaloids, steroids, terpenoids, saponins, cardiac glycosides, tannins and reducing sugars, and absence of anthroquinone and flavonoids corroborates the assertion of Vayalil (2012) that date and cashew nut are rich sources of phytochemicals. The results of this study also agree with the findings of Aletor *et al*. (2007) who reported the presence of reducing sugar, phenols, flavonoids, and terpenoids in date.

The presence of leucine in the food samples is very useful in the body as it balances the isoleucine which helps in the regulation of the thymus, spleen, pituitary, the metabolism and forming haemoglobin (Aletor *et al*., 2007). Also, the presence of lysine in date, walnut, cashew nut and bush mango seed shows that these food samples can help in the functioning of the liver, gallbladder and pineal and mammary glands (Omueti *et al*., 2009). The presence of tryptophan, threonine, and valine is an indication that the plants can help in the generation of cells, red and white blood corpuscles, involved in the functioning of the mammary glands and ovaries (Omueti *et al*., 2009). Vayalil (2012)

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documented that food which show antioxidant potential may contain constituents with strong proton-donating abilities. These antioxidant activities are probably related to polyphenols, in particular flavonoids, which react with the free radical (DPPH) via the phenolic hydroxyl groups, giving hydrogen forming thus stable complexes (DPPH-H) that are not able of initiating oxidation reactions (Athamena *et al.,* 2010). These observations reinforce those of Jayaprakasha and Bhimanagouda (2007) working on the antioxidant capacity of citrus and showed a good antioxidant activity of extracts related to the content of polyphenols. Phenolic compounds are known as substances with potential antioxidant capacity to trap free radicals and reactive forms of oxygen (Vayalil, 2012). Therefore, flavonoids could be the reason for the antioxidant activities of the studied functional foods.

CONCLUSION

Date, walnut, cashew nut and bush mango seed are food consumed by most people without enough and proper knowledge of their compositions. These food samples have proven to contain carbohydrate, proteins, fat and crude fibres. Proximate analysis revealed that these food samples have low ash content and low moisture content, hence have high shelf life. Mineral composition analysis showed that the samples contain calcium, sodium, potassium, nitrogen, magnesium and phosphorus in varied proportions. The presence of essential amino acids in all the studied food samples was also observed. Anti-nutritional factors were low in all the samples hence high bioactivity of the nutrients. They also possess high antioxidant activities. Therefore, date, walnut, cashew nut and bush mango seed not only delicious with pleasant taste and fleshy mouth feel but also possess potentials as functional food components.

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