Original Research Article

Phytochemical and Nutritional Profile, Mineral Ratio and Mineral Safety Index of Young and Matured Corn Silk Collected from Ekiti State, Nigeria

ABSTRACT

Corn silk is an agricultural waste material from corn cultivation. The need for a supplement feed material that would be readily available, affordable and has nutritional qualities prompted this study. Fresh and dry corn silk were collected from a farm land in Ado Ekiti, Ekiti State, Nigeria and evaluated for phytochemical and nutritional composition using standard techniques. The phytochemical analysis revealed that both the young and matured corn silk contained alkaloids, tannins, saponins, flavonoids, phenols, steroids and reducing sugar. The qualitative phytochemical estimates showed high concentration of flavonoids and total phenols while tannins were found in moderate quantities. The proximate estimation (%) revealed high values of carbohydrate and crude fiber, moderate crude protein and ash, low crude fat, low moisture as well as high energy content in young and matured corn silk respectively. Both samples contained high K, P, Ca, Mg, moderate Na, Fe, Mn, Zn and Cu while Pb and Ni, toxic metals, were absent. The results showed low mineral CV% which ranged from 1.32-38.92. The results of the mineral safety index were lower than the standard, an indication that there would be no mineral overload. The two corn silk samples were rich in active secondary metabolites which could offer protective health benefits, also safe and contained nutritional qualities that could make them suitable to be incorporated into man’s diet and domestic feed.

Keywords: Corn silk, Phytochemical, Proximate, Domestic feed, Nigeria

1 INTRODUCTION

Corn (*Zea mays* Linn) popular called maize belongs to the family Poaceae. It is the most abundant staple food crop grown all over the world particularly in Africa. Maize is an important crop in Africa mainly in the eastern and southern regions where it serves as dominant food crop and the mainstay of rural diets [1]. It is a major important cereal being cultivated in the rainforest and derived savanna zones of Nigeria [2].

Corn silk, the yellowish thread like strands from the female flower of maize are often regarded as a waste material from corn cultivation [3]. In most cases, corn silk threads are normally discarded after corn harvesting. The colour of the corn silk are usually light green at first and later turn into red or yellow and finally light brown at maturity. The major function of corn silk is to trap the pollen for pollination.

Corn silk is harvested just before pollination occurs when needed for medicinal purposes. It can also be used in fresh or dried form [4]. This agricultural waste material has been consumed for a long time as a therapeutic remedy for various ailments. It has been reported to be used as traditional medicine in many parts of the world such as China, Turkey and Africa. It is commonly used for the treatment of edema, kidney stones, diuretic, prostrate disorder, obesity and urinary infections [5,6,7]. Corn silk has been used based on folk remedies as an oral antidiabetic agent in China for decades. It is also considered to be effective in treating hypertension, nephritis and prostatitis [8].

Recently, there is a sharp increase in the demand for animal feeds in Nigeria fueled by competing use and demands for corn and soybeans. There is a pressing need for feed sources that would serve as supplements. Such feeds should be readily available, sourced locally, affordable and at the same time, rich in energy, provide essential nutrients and safe for consumption. In order to achieve this, attention is now being shifted to neglected, underutilized crops as well as crops regarded to as agricultural waste.
Hence, this study is aimed at investigating the phytochemical and nutritional profile, mineral ratio and mineral safety index of young and matured corn silk, an agricultural waste material from corn cultivation in Ekiti State, Nigeria.

2. MATERIALS AND METHODS

2.1 Experimental Site

Samples of young and matured corn silk used in this study were collected from Ekiti State University campus, Ado Ekiti, Ekiti State, Nigeria. The Campus is location on GPS of Latitude: 7.7094175 and Longitude: 5.25069 while the experiment was conducted at Department of Chemistry, Afe Babalola University, Ado Ekiti, Ekiti State, Nigeria.

2.1.1 Sample Collection

The plant samples were rinsed with distilled water to remove the sand and other impurities. The corn silk materials were air dried for three weeks. The dried samples were then ground into a powder using an electric blender (Binatone BLG-600SMK2). The powdered sample was used for phytochemical, proximate and mineral analyses.

2.2.1 Qualitative Phytochemical Screening

2.2.2 Test for flavonoids

Flavonoid was tested using 1 g of the extract dissolved in 1% Aluminum chloride in methanol. Few drops of concentrated HCl, magnesium turnings and potassium hydroxide solution were added. Orange to pink colour change indicated the presence of flavonoids.

2.2.3 Test for Alkaloids

Alkaloid was detected by taking 1 g of the powdered sample and stirred with 5ml of 1% HCL on a steam bath and filtered. 1ml of the filtrate was treated with a few drops of Dragendorff's reagent (Bismut nitrate + conc, HCl). A change in the colour of the sample to black indicated the presence of alkaloids.

2.2.4 Test for Saponins

A portion (2 g) of the dry powdered sample was taken and boiled in 20 cm^3 of distilled water in a water bath and then, filtered. The filtrate (5 cm^3) was mixed with 5 $cm^3$of distilled water and shaken vigorously. The formation of stable foam was taken as an indication for the presence of saponins.

2.2.5 Test for Tannins

To test for tannins, 1 g of the sample was taken and boiled in 10 ml of distilled water in a test tube and filtered. A few drops of 5% ferric chloride were added. Black colouration or precipitation showed the presence of tannins [9].

2.2.6 Test for Phenols

For phenol detection, 2 ml of ferric chloride ($FeCl_3$) solution was added to 2 ml of the sample extract in a test tube. Formation of deep bluish green solution showed the presence of phenol.

2.2.7 Test for Steroids

The presence of steroids was confirmed by taking 0.5 ml of sample extract and dissolved in 3 ml of chloroform, then filtered. A few drops of concentrated Tetraoxosulphate (VI) acid were added. Reddish brown colour at the lower layer of the tube indicated the presence of steroid.

2.2.8 Test for Phlobatannins

In a test tube, 0.5 ml of the extract was taken, 3 ml of distilled water was added and shaken for a few minutes then 1 % aqueous hydrochloric acid (HCl) was added and boiled on water bath. The formation of red colour indicated the presence of phlobatanins.

2.2.9 Test for Terpenoids

One gram of each plant sample was mixed with 2 ml of chloroform and 3 ml of conc. H_2SO_4 was carefully added to form layer. A reddish-brown colouration of the interface indicated the presence of terpenoids.

2.3.0 Test for cardiac glycosides (Keller-Killiani test)

One gram of plant sample each was shaken with 5 ml of distilled water in a test tube and 2 ml of glacial acetic acid containing a few drops of ferric chloride was added slowly along the side of the test tube. Formation of brown ring at the interface gave positive indication for cardiac glycoside. A violet ring may also appear below the brown ring [10].

2.4 Quantitative Estimation of the Phytochemicals

The amounts of phytochemical in the sample was further determined using the standard procedure of Harbone [11], Boham and Kocipal [12] and Obadoni and Ochukwo [13].

2.4 Proximate Analysis

The estimation of moisture, ash, crude fat and crude fiber were determined in accordance with the official method of AOAC [14]. The moisture content was determined by taking 2 g of the dried sample and drying at 105 ^{0}C in an ovum until a constant weight was reached. For total ash determination, the dried plant sample was weighed and converted to dry ash in a muffle furnace at 550 ^{0}C for incineration. The crude fat content was determined by extraction with hexane, using Soxhlet's apparatus. The crude protein content was calculated as percent of nitrogen value and was converted to protein by multiplying with a factor of 6.25 [14]. Crude lipid content of the sample was determined using Soxhlet type of direct petroleum ether solvent extraction method. Carbohydrate was determined according Onwuka [15] by calculating the difference between the sums of all the proximate composition from 100 percentage.

2.5 Determination of the mineral composition

Elemental analysis was carried out using atomic absorption spectrophotometer (Buck Scientific Model-210 VGP) for sodium, potassium, manganese, magnesium, iron, calcium, zinc and copper while phosphorus was determined calorimetrically according to method described by State *et al*. [16].

2.6 Determination of Energy

This was calculated using Atwater factor method as described by Osborne and Voogt [17]. The estimated energy value in the samples in Kilocalorie (Kcal/100g) was determined by adding the multiply values for crude fat, crude protein and carbohydrate using the factor (9Kcal, 4Kcal and 4Kcal) respectively. The energy value in Kilojoule was determined by adding the multiply values for crude fat, crude protein and carbohydrate using the factor (37Kcal, 17Kcal and 17Kcal) respectively.

2.7 Other Calculations

Other calculations made from the mineral elements include mineral ratios and Mineral Safety Index (MSI).

2.8 Statistical Analysis

Descriptive statistics (mean, standard deviation and coefficient of variation) were determined [18].

3. RESULTS

3.1 Phytochemical Screening of young and matured silk corn

The young and matured silk corn samples were screened for bioactive phytochemicals. The results revealed the presence of alkaloids, tannins phenols, saponins, flavonoids, steroids and reducing sugars while terpenoids and cardiac glycosides were absent in both the young and matured corn silk (Table 1). Quantitative phytochemical estimates of the corn silk samples showed low concentration of alkaloids (0.23 and 0.28 MgTAE/g), high flavonoids (8.22 and 14.37MgQE/G) and high total phenol (12.16 and 6.94 MgAE/g) in young and matured silk respectively (Table. 2).

3.2 Proximate composition of young and matured corn silk

The result of the proximate composition (%) revealed low moisture content (8.76 and 9.11), crude fat (1.21 and 1.29), moderate crude protein (5.74 and 4.33), ash content (5.52 and 5.53), high crude fiber (10.20 and 12.42) and carbohydrate (68.27 and 67.34) in young and mature silk respectively (Table 3). The result of the proportion of percentage energy contributed by crude fat, crude protein and carbohydrate to total metabolizable energy is given in Table 4. The total energy for young and matured corn silks were 1302.94kJ/100g (306.93Kcal/100g) and 1265.78kJ/100g (298.23Kcal/100g) respectively with both the kJ and Kcal values very close with CV% range of 2.03-2.05. The utilizable energy in the young and matured silks were in order of PEC%>PEP%>PEF%. The UEDP% (assuming 60% of protein energy utilization) was low 4.49% in young silk and 5.43% in matured silk.

3.3 Mineral composition of young and matured corn silk

The result shown in Table 5 revealed the mineral composition of young and matured corn silk. The Table equally revealed the mean, standard deviation and coefficient of variation percent. The composition of mineral (mg/100g) investigated were: Na (42.70 and 40.40), K (8425 and 6630), P (584.80 and 591.33), Ca (140.14 and 137.55), Mg (104 and 119.70), Fe (7.87 and 6.15), Mn (4.11 and 3.13), Cu (1.50 and 1.10), Zn (9.21 and 5.23) in young and matured silk respectively while Pb and Ni were not detected in the samples. The CV% of the mineral ranged from 1.32-38.92.

3.4 Calculated Mineral Ratio

Table 6 depicts the calculated mineral ratios of young and matured corn silk. Na/K ratio had the lowest value of 0 while Ca/K had the highest value of 52.03. Mineral difference of the two samples is shown in Table 7.The result revealed that seven minerals (Na, P, Ca, Fe, Mn, Cu, and Zn) had greater values in young silk than matured silk. The % difference ranged between 1.85-43.21 (both coming from Ca and Cu).

3.5 Calculated Mineral Safety Index

Table 8 showed the mineral safety index (MSI) of Na, Mg, P, Ca, Fe, Zn, and Cu of the two samples. The MSI values were; Na (0.41 and 0.39), Mg (3.90 and 4.49), P (4.87 and 4.93), Ca (1.17 and 1.15), Fe (3.52 and 2.75), Zn (20.3 and 11.5) and Cu (16.5 and 12.10) in young and matured silk respectively. The highest level of index was recorded in Cu while Na had the least value.

Table 1: Qualitative phytochemical screening of young and matured corn silk

Parameters	Young silk	Matured silk
Alkaloids	+	+
Tannins	+	+
Phenol	+	+
Saponins	+	+
Flavonoids	+	+
Terpenoids	-	-
Steroids	+	+
Cardiac Glycosides	-	-
Reducing Sugar	+	+

Key: + (presence), - (absence)

Table 2: Quantitative phytochemical estimates of young and matured corn silk

Phytochemical	Young silk	Matured silk
Alkaloids (MgAT/g)	0.23±0.01	0.28±0.00
Saponins (MgGAE/g)	0.14±0.00	0.18±0.00
Total phenol (Mg GAE/g)	12.16±0.06	6.94±0.06
Tannins (MgTAE/g)	5.70±0.14	4.15±0.01
Flavonoids (MgQE/g)	8.22±0.03	14.37±0.24

Values are expressed as means $\pm$ SD, n $=$ 3

Table 3: Proximate composition (%) of young and matured corn silk

Proximate	Young silk	Matured silk
Moisture content	8.76±0.06	9.11±0.02
Crude protein	5.74±0.06	4.33±0.07
Crude Fat	1.21±0.04	1.29±0.01
Ash	5.52±0.12	5.53±0.12
Crude fiber	10.20±0.05	12.42±0.06
Carbohydrate	68.27±0.04	67.34±0.01

Values are expressed as means $\pm$ SD, n $=$ 3

Table 4: Proportion of percentage contribution from fat, protein and carbohydrate to total energy

Parameter	Young silk	Matured silk	Mean	SD	CV%
Total energy (E in kJ/100g)	1302.94	1265.78	1284.36	26.27	2.05

(E in kcal/100g)	306.93	298.23	302.58	6.15	2.03
PEF % (E in kJ/100g)	(3.44) 44.77	(3.77) 47.73	3.59	0.21	5.85
(E in kcal/100g)	(3.52) 10.8	(3.89) 11.61	3.71	0.26	7.01
PEP % (E in kJ/100g)	(7.48) 97.58	(5.82) 76.61	6.65	1.17	17.59
(E in kcal/100g)	(7.48) 22.96	(5.81) 17.32	6.65	1.18	17.74
PEC % (E in kJ/100g)	(89.07) 1160.6	(90.44) 1,145	89.76	0.97	1.08
(E in kcal/100g)	(88.97) 273.1	(90.32) 269.4	89.65	0.95	1.06
UEDP %	4.49	5.43	4.96	0.66	13.31

PEF = proportion of total energy due to fat; PEP = proportion of total energy due to protein; PEC = proportion of total energy due to carbohydrate; UEDP = utilization of 60% of PEP %,. SD: Standard deviation, CV: Coefficient of Variation

Table 5: Mineral composition (mg/100g) of young and matured corn silk

Parameter	**Young silk**	**Matured silk**	**Mean**	**SD**	**CV%**
Sodium	42.70	40.40	41.55	1.62	3.89
Potassium	8425.00	6630.00	7527.5	1269.2	16.86
Phosphorus	584.80	591.33	588.07	4.62	0.78
Calcium	140.14	137.55	138.80	1.83	1.32
Magnesium	104.00	119.70	111.85	11.10	9.92
Iron	7.87	6.15	7.01	1.21	17.26
Manganese	4.11	3.13	3.62	0.69	19.06
Copper	1.50	1.10	1.30	0.28	21.54
Zinc	9.21	5.23	7.22	2.81	38.92
Lead	Nd	Nd	-	-	-
Nickel	Nd	Nd	-	-	-

Table 6: Calculated mineral ratio of young and matured corn silk

Parameter	**Standard**	**Young silk**	**Matured silk**	**Mean**	**SD**	**CV%**
Na/K	0.06	0.006	0.006	0.006	0.0	0
K/Na	5.0	197	164	181	23.33	12.93
Na/Mg	4.17	0.411	0.338	0.375	0.05	13.33
Ca/Mg	1.0	1.35	1.15	1.25	0.14	11.20
K/(Ca+Mg)	2.2	34.5	25.8	30.2	6.15	20.36
Ca/P	≥0.5	0.239	0.233	0.236	4.24	1796
Ca/K	4.00	0.017	0.021	0.019	2.82	52.03
Fe/Cu	5.59	5.25	5.59	5.42	0.24	4.43
Zn/Cu	4.75	6.14	4.75	5.45	0.98	18.08

Table 7: Mineral difference in young and matured corn silk

Minerals	**Differences**	
	mg/100g	%
Sodium	2.30	5.39
Potassium	1,795	21.31

Phosphorus	-6.53	-1.12
Calcium	2.59	1.85
Magnesium	-15.7	-15.10
Iron	1.72	21.86
Manganese	0.98	23.84
Copper	3.98	43.21
Zinc	0.40	26.66

Table 8: Mineral Safety Index (MSI) of Na, Mg, P, Ca, Fe, Zn and Cu in the young and matured corn silk

Mineral	RAI	TV of MSI	Young silk			Matured silk		
			CV	D	%D	CV	D	%D
Na	500mg	4.80	0.410	4.39	91.5	0.390	4.41	91.9
Mg	400mg	15.0	3.90	11.1	74.0	4.49	10.5	70.1
P	1200mg	10.0	4.87	5.13	51.3	4.93	5.07	50.7
Ca	1200mg	10.0	1.17	8.83	88.3	1.15	8.85	88.5
Fe	15mg	6.70	3.52	3.18	47.5	2.75	3.95	58.9
Zn	15mg	33.0	20.3	12.7	38.6	11.5	21.5	65.2
Cu	3mg	33.0	16.5	16.5	50.0	12.10	20.9	63.3

4. **DISCUSSION**

The results of analyses of medicinally important compounds in young and matured corn silk revealed that both the samples being analyzed are rich in bioactive compounds having medicinal properties. The qualitative estimation of the percentage crude yield of phytochemical constituents of the two samples studied revealed low quantity of tannins and high quantity of flavonoids and total phenols. It has been reported that saponins are used medicinally in hypercholesterolemia, antioxidant, anticancer, anti-inflammatory and weight loss [19]. In addition, it is used to stop bleeding, treating wounds and ulcer. It helps red blood cells to precipitate and coagulate [20]. Alkaloids have been reported to exhibit analgesic, antispasmoic and antibacterial properties [21]. Flavonoids are noted for their antioxidative, antibacterial, anti-inflammatory, anticancer and also potential antiviral properties [22,23].

Nutrients are substances found in food which drive biological activities. Nutrients support vital functions such as growth, the immune, the central nervous system and also preventing diseases. The proximate content of the young and matured silk was investigated in order to find out the nutritive values of the two samples for possible incorporation into human diet and domestic animal feeds. The results of the proximate composition revealed that the silk samples have low moisture content compared to 16.11% and 14.10% report for *Amaranthus cruentus* and *Ocimum gratissimum* [24]. The low moisture content in the two samples would afford long shelf life for silk samples. The crude protein content in the young and matured corn silk were high compared to1.98% reported for *Securinega virosa* leaves [25] but low to the value (27.13%) reported for *Crassoceph*alum *crepidioides* [26].The crude protein content was higher than 1.82%, 2.86% and 3.50% reported for *Talinum fruticosum*, *Murraya koenigii* and *Corchorus olitourus* respectively [27]. Protein intake can help in formation of hormones, which control several biological functions in the body such as growth, tissue repair and maintenance. The crude fat content in this study were low compared to the previous research work of Alowode *et al*. [28] on *Cordyllia pinnata* and Oyeyemi *et al*. [29] on *Myrianthus arboreus* and *Spagonophorus sporgonophora*. The crude fat values were high compared to 0.4% and 0.3% values reported in the work of Saudi and Jideobi [30] for *Talilum fruticosum* and *T. occidentalis*. Iludibia *et al*. [31] reported that fat yield more energy per gram than carbohydrate. However, it should be consumed with caution so as to avoid obesity and other related complications. The relatively low crude fat in the young and matured silk is cheering because the silk can be recommended as part of weight reducing diets.

The crude fiber content for the young and matured silk were comparatively lower than the values reported by Baloch *et al*., [32] for dehydrated and open sun Dried Cauliflower samples. However, the values obtained in this present study were high compared to 3.17% reported for *Parkia biglobosa* [33]. The crude fiber obtained in this study is desirable because adequate consumption of dietary fiber may help to aid digestion, prevent diabetes and high levels of blood cholesterol [34]. Carbohydrate is one of the major sources of nutrition in animals including humans. It provides fuel for the central nervous system and energy for working muscles. Carbohydrate contents of the two silk samples investigated were higher than the values reported in the previous works of Orhuamen *et al*. [35] for sixteen vegetables collected from Lagos State market, Nigeria and Idoko *et al*. [27] for nine leafy vegetables consumed in Nigeria. The high content of carbohydrate in the silk samples is pleasing and suggesting that the silk samples can serve as energy rich food for man and animal.

The result of the mineral analysis of the young and matured corn silk indicated that K and P were found in high concentrations while Na, Ca and Mg were in moderate levels and Fe, Mn, Cu and Zn were found in low concentrations. Sodium and Potassium are important in the transport of metabolites in the human body. The Potassium levels in the present study were higher than the levels in *Amaranthus dubius* (170.82 mg/100g) and *Lomariopsis guineensis* (367.48 mg/100g) [36] but lower than the value in Apple *Malau domestica* (28,010 mg/100g) [37]. The result of our finding corroborated the report of Saranya and Vijithan [38] who reported potassium as the major nutrient in corn silk. Sodium and Potassium play an important role in controlling nerve irritability, glucose absorption and promote normal retention of protein during growth [39]. The phosphorus levels obtained in the studied samples were comparatively higher than the value in *Prosopis africana* (196.40 mg/100g) [40]. However, the values were lower than the Recommended Daily Allowance (RDA) of 800 mg. Phosphorus is always found with Ca in the body, both contributing to the supportive structures of the body. Calcium contents in this present report were higher when compared to the value 65.0 mg/100g (*Cajanus cajan*) [41] but lower than 220.87 mg/100g reported for *Anarcadium occidentale* [42]. The Ca level could be said to be low since the values can only contribute about 11.68% and 11.46% respectively to the Recommended Daily Allowance (RDA) value of 1200 mg. Deficiency of Ca and P can cause metal deficiency syndrome like rickets in children, calcification of bones [43] as well as oeteoporosis among older people [44].

The Iron levels recorded in this study were higher compared to the Fe value of 1.04 mg/100g reported for *Vigna unguiculata* [45] but lower than 9.30 mg/100g reported for *Glycine max* [46]. The values were also lower than the daily requirement of iron by human beings which is 15 mg for children, 12 mg for men and 18 mg for women [47]. These values could help in boosting the blood level in aneamic condition. The Magnesium levels of the two corn silk samples investigated were higher than the values (2.68 mg/100g and 3.90 mg/100g) reported for *Myriathus arboreus* and *Spargonophorus sporgonophora* leaves respectively [29]. The RDA for magnesium in adult is given as 350 mg/day [48]. Hence, the young and matured corn silks could contribute 29.71% and 34.20% respectively to the recommended daily allowance (RDA) for an adult man. The Cu contents were comparatively lower than 2.84 mg/100g found in *Lablab purpureus* [49]. Cu, although, a trace element is essential in human body and exists as an enzyme that catalyzes the oxidation of iron ion [50]. The Zn concentrations of the samples were higher than the values 1.82 mg/100g (*Ocimun grattisimum*) and 2.60 mg/100g (*Gnetum africanum*) reported in the previous work of Idoko *et al*. [27]. The values could not meet the minimum Zn allowance (about 15-20mg) per day. Zn is useful for protein synthesis, normal body development and convalescence [51]. Manganese is an activator of many enzyme systems and maintains the electrical potential in nerves [52].

The total metabolizable energy obtained for both young and matured corn silk were high compared with values reported for some edible vegetables *Amaranthus dubis* (109.78 kcal/100g) and *Gnetum africanum* (268.02 kcal/100g) [36]. However, the values in this present study were comparatively lower than 354.20 kcal/100g for *Telfaria occidentalis* and 363.60 kcal/100g for *Moringa oleifera* respectively [53]. The values also compared favourably with 300.94 kcal/100g reported for water spinach leaves [54]. Carbohydrate contributed the highest energy values followed by protein. The CV% of the values was close with a range of 1.06-17.74 which showed that the values were close on parameter basis. The results of utilizable energy due to protein (UEDP%) in this present finding were low (assuming 60% of protein energy utilization). The values were lower than 8% recommended safe level for adult man who requires about 55 g protein per day with 60% utilization. This implies that other foods such as legumes may be added to the samples to meet the protein requirement when use as domestic feeds. The low PEF% of the young and matured corn silk was as a result of low level of lipid which in turn plays a significant role in prevention of chronic diseases such as liver cirrhosis, diabetes and heart related diseases [55].

Mineral ratios are often more important in determining nutritional deficiencies and excesses than mineral alone. Mineral ratios represent homeostatic balances. They are also indicative of disease trends as well as predictive of future metabolic dysfunction. The Na/K ratios in the two samples were lowered than the 1 recommended for the prevention of high blood pressure [56]. It is observed that prevalence of hypertension in Nigeria is high and increasing on daily basis [57]. It is already becoming a public health burden hence, food low in sodium and high in potassium should be encouraged. The low Na/K ratio in the samples is good for human health and the corn silk could be recommended for people suffering from high blood pressure diseases. The Ca/Mg ratios were lower than the required 6.67. The ratio of Calcium to Magnesium intake has gained attention in recent years. Deluccia *et al*. [58] reported that a ratio above 2:1 has been associated with increased risk of metabolic, inflammatory and cardiovascular disorder. The Ca/Mg ratios in this present study could not pose any health risk to the consumer. The milliequivalent ratios [K/(Ca + Mg)] in the silk samples were higher than the ideal value of 2.2 [59]. The high levels obtained in the study were due to the relative high values of K as against low level of Ca and Mg. The low calcium and magnesium could be supplemented with food rich in Ca and Mg to boost the milliequivalent ratios [K/(Ca + Mg)]. The Zn/Cu ratios obtained conform to the standard value of 4.75. Values below the standard value suggest possible copper toxicity and zinc deficiency problems. The ratio of Zn/Cu not only reflects the individual level of trace elements, but also seems to have an important impact on metabolism, indicating that these trace elements play an important role in the pathogenesis of metabolic diseases [60]. Ca/K ratios were low compared to the ideal level (4.00). Low Ca/K ratios is considered good since a high Ca/K ratio would imply reduce thyroid function which if this imbalance persists for a long time could lead to symptoms such as fatigue, dry skin, overweight and constipation. Fe/Cu ratios in this present study were within the ideal value 5.59 requirement for favourable Fe absorption in the body. High copper relative to iron could impair many functions of iron metabolism and iron-deficiency anemia. Na/Mg ratios were lower than the ideal 4.17. However, lead was absent in the samples hence, the toxic ratios Ca/Pb, Zn/Pb and Fe/Pb could not be ascertained. Absence of lead in the samples was cheering because its presence which might be as a result of onset of pollution could pose health challenges. Toxicity of lead could lead to calcium displacement which in turn may raise glucose level. The result of mineral difference in the two samples indicated that young silk had greater value in seven minerals (Na, P, Ca, Fe, Mn, Cu, and Zn) while matured silk had greater value in two minerals (P and Mg). The least % difference was obtained in Ca and highest % difference came from Cu. The result is an indication that the young silk is richer in mineral content compared to the matured silk.

5. CONCLUSION

The results of the phytochemical investigation showed that both the young and matured silk corn were rich in phytochemical and could be used to justify silk corn as a therapeutic remedy for various diseases and illnesses. The corn silk were rich in crude protein, crude fiber with low crude fat. The high total energy in the two samples could imply a good source of energy. They equally contained essential minerals K, P, Ca, Mg and moderate Fe. The absence of lead, a toxic metal would make the corn silk safe for consumption while the mineral safety index implies that there would be no mineral overload in the body of the consumer. The plant materials could be recommended as good medical and supplement diets for man and domestic animal.

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