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Phytochemical Constituents and Nutritional Evaluation of Three Selected Edible Flowers in Ado-Ekiti, Nigeria

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ABSTRACT

The study examined the bioactive phytochemical and nutritional compositions of *Hibiscus rosasinensis*, *Moringa oleifera* and *Musa paradisiaca* flowers collected from Ado Ekiti, Ekiti State, Nigeria. Various researches suggest that some flowers are eaten by man since ancient times and have therapeutic properties as well as nutritional value. Fresh flowers were collected, washed, dried and ground into powder for analysis. The results of the phytochemical screening revealed the presence of Flavonoids, Tannins, Saponins, Phenols, Terpenoids, Phlobatannins, Cardiac glycosides, Anthraquinones and Steroids in *M. oleifera* and *M. paradisiaca* flowers while Flavonoids, Alkaloids, Tannins, Phenols and Terpernoids were absent in *H. rosasinensis*. Quantitatively, *M. oleifera* and *M. paradisiaca* contained (mg/100g) Tannins 54.61 and 48.93, Saponins 46.51 and 25.42, and Phenols 44.37 and 36.09 respectively. *H. rosasinensis* contained 63.03mg/100g saponins while the estimated quantity of flavonoids in *M. paradisiaca* was 17.98mg/100g. The percentage estimation of the proximate composition of the three flowers revealed carbohydrate values ranging from 49.01 to 61.11, crude protein 1.90 - 3.07, crude fiber 17.27 - 29.00, ash 1.89 - 3.34, crude fat 3.36 - 5.60 and moisture content 12.37 - 13.66. All the flowers showed high level of mineral elements in order of Na>K>Ca >Cu>Fe>Mn>Mg and Zn while Pb and Ni found in *M. oleifera* and *M. paradisiaca* were below the permissible level and considered safe for human consumption. The presence of phytochemical in the flowers suggests possible preventive and curative property of the flowers. Also, the flowers are rich in carbohydrate, fiber and minerals hence can be fortified as supplementary food for man and livestock feeds.

Keywords: Ekiti State, Flower, Nutritional composition, Phytochemical, Supplementary food

INTRODUCTION

The beauty of many plants that offer great aesthetic value and ecological balance in the ecosystem is usually conferred on them by their flowers. Apart from this, edible flowers also play a significant role in the food culture of people in Nigeria and Africa as a whole. They are considered as foods from plant with valuable sources of nutrients especially in rural areas. Like vegetables, they have both medicinal and nutrition properties (Yashaswini *et al*., 2011). Edible flowers have been consumed for thousands of years in China and Japans (Mlcek and Rop, 2011). In other parts of the world, flower consumptions have been reported for centuries and are consumed as ingredients in different meals, salads and beverages (Navarro-gonzalez *et al*., 2015). In Nigeria, edible flowers are not considered as important items of diet in many homes. They are mostly consumed in the rural area or in the communities where they have traditional knowledge of their nutritional and therapeutic values. Flowers play many beneficial roles ranging from nutritional, social, cultural, religious, health and environmental to mention but a few.

Unfortunately, edible flowers are underutilized when compared to the green leafy vegetables. The reasons are not far fetch from the fact that little knowledge was known and documented about the nutritional and medicinal properties of these flowers which abound in Nigeria. Flowers are known to contain both beneficial and toxic substances that vary over a wide range of concentrations. Flowers to be incorporated in human diets must therefore be toxic free and have good nutritional properties (Alasalvar *et al*. 2013).

According to Amin *et al*. (2013), a large number of people in developing countries therefore live in abject poverty. Such people cannot afford food rich in essential nutrients needed for growth and development. Edible flowers can contribute substantially to protein, minerals, vitamins, fibers and other important nutrients which are inadequate in the daily diets of these people. Edible flowers are cheap, easily cultivated and readily available throughout the seasons in Nigeria. They can supplement fruits, fish, meat, egg and other food items that are out of reach of the poor populace (per. com). Edible flower also contain bioactive compound like tannins, flavonoids, phenols, essentials oils which produce definite physiological

action on human body (Edoga *et al*., 2005) that can bring about healing.

Hibiscus rosasinensis (L) belongs to the family Malvaceae. It is an evergreen herbaceous plant extensively cultivated as an ornamental plant. The plant is distributed throughout the tropics and sub-tropical regions. Leaves are ovate or ovate-lanceolate, entire at the base and coarsely toothed at the apex. Flowers are pendicillate, actinimorphic, pentamerous and complete. Its corolla consists of five petals, red in colours and about 8cm in diameter. Its fruit is very rare but where found, is a capsule about 3 cm long. The flowers and the leaves of Hibiscus are highly nutritious and are used for culinary purposes (Duke and Ayensu, 1985). More so, various parts of this plant like leaves, flowers and roots have been reported to possess medicinal properties that allow for their use as aphrodisiac, laxative and emollient. Traditionally, the leaves of the plant are used in fatigue and skin disease (Kumar and Singh, 2012). The flowers are used to treat epilepsy, leprosy and diabetes (Kasture *et al*., 2000).

Moringa oleifera (Lam.) is a fast growing, evergreen or deciduous tree that belongs to the family Moringaceae. The tree grows widely in the tropics and sub-tropics of Asia and Africa. It typically ranges in height from 5 to 10 meters (Morton, 1991). The leaves are bipinnate or more commonly tripinnate, up to 45 cm long and are alternate, spirally arranged on the twigs. The leaflets are finely hairy, green, entire margins and are rounded or blunt-pointed at the apex and short-pointed at the base. Fruits are yellowish-white, borne on slender, hairy stalk in spreading or drooping axillary, clusters, 10-25 cm long and 2.0 to 2.5 cm broad, usually containing up to 26 seeds. The leaves, fruits, flowers and unripe pods on Moringa tree are used as nutritive vegetables in many countries of the world (Answar and Bhanger, 2003; Answer *et al*., 2005). Its flowers have been reported to contain nine amino acids, sucrose, traces of alkaloids and ash which is rich in potassium and calcium (Ruckimani *et al*., 1998).

Musa paradisiaca (L.) commonly called plantain is an herbaceous plant, belonging to the family Musaceae. It has a robust tree like pseudo-stem which consists of overlapping leaf bases forming a cylindrical structure almost 45 cm in diameter (Blomme and Ortiz, 2000). The leaves are large, elongated, oval and deep-green with a prominent midrib (Pradeep *et al*., 1986). The plant produces a single inflorescence and large bracts opening in succession, ovate, concave, dark red and somewhat fleshy. Its fruits are oblong and fleshy. The various uses of *M. paradisiaca* flowers, bracts, ripe and unripe fruits, leaves, root and stems are documented in traditional and scientific literatures. Extracts from its edible flowers and their active constituents have been used for the treatment of various ailments in man (Kumar *et al*., 2012). For example, plantain flowers are used in the treatment of dysentery and hemorrhage. The bract of *Musa paradisiaca* has medicinal applications in bronchitis, dysentery and ulcer. Bracts when cooked are used to treat diabetics (Peter, 2011).

Several researchers around the world have provided information on the nutritional profile, biological and pharmacological activities of different edible flowers. In Nigeria, despite the enormous health promoting benefits of edible flowers, there is paucity of information on these vast but underutilized edible materials (Shindu *et al*., 2008; Navarro-gonzalez *et al*., 2011 and Yashaswini *et al*., 2011). Hence, there is a need to explore the potential of these edible flowers through adequate scientific research activities. This work was carried out in order to evaluate the phytochemical and nutritional composition of three selected edible flowers obtained from Ado-Ekiti, Ekiti State, Nigeria.

MATERIALS AND METHODS

Sample Collection

Fresh flowers of *H. rosasinensis*, *M. oleifera* and bracts of *M. paradisiaca* were collected from Ekiti State University, Ekiti State, Nigeria. The botanical authentications of these materials were done at the Herbarium of the Department of Plant Science and Biotechnology, Ekiti State University. The specimens were washed with distilled water, sun dried for three days to reduce moisture content and later air dried. The dried samples were ground using blending machine (Akai BD 012) and packed in a separate plastic container. The samples were taken to the laboratory for chemical, proximate and mineral compositions analyses.

Preparation of Plant materials

The aqueous extract of each of the plant samples was prepared by soaking 50 g of each dried powdered sample in 500 cm^3 of distilled water, shaken intermittently and then allowed to stay for 48 h. It was later filtered using Whatman No. 42 filter paper.

Phytochemical Analysis

Phytochemical screenings of the aqueous extract and dried powder of the selected flowers were carried out using standard procedures as described by Trease and Evans (1989); Sofowora (1993).

Quantitative Analysis of the Phytochemicals

Test for tannins: A portion (2 g) of the dried powdered sample each was taken and boiled in 20 cm^3 of distilled water in a separate test tube and then filtered. A few drop of 0.1% Ferric Chloride was added and the solution was observed for brownish green colouration (Banso and Adeyemo, 2006).

Test for Saponins: Portions (2 g) of each of the powdered sample was 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 distilled water and shaken vigorously. The formation of stable foam was taken as an indication for presence of saponins.

Test for alkaloids: To 3 cm^3 of aqueous extract, 3 cm^3 of 1% HCl was added and stirred on a steam bath and filtered. Mayer's reagent (Potassium mercuric iodide) was then added to the filtrate. Formation of yellow precipitate shows the presence of alkaloids.

Test for flavonoids: 5 cm^3 of 10% dilute ammonia solution was added to 1 cm^3 of aqueous extract of the plant. This was followed by the addition of few drops of concentrated H_2SO_4. A yellow colouration observed indicated the presence of flavonoids.

Test for Phlobatannins: A portion (2 cm^3) of aqueous extract was added to 1% hydrochloric acid and then boiled. Formation of red precipitate confirmed the presence of phlobatannins.

Test for Terpernoids: A portion (5 cm^3) of each aqueous extract of the sample was mixed with 2 cm^3 of Chloroform and 3 cm^3 of concentrated H_2SO_4 was carefully added to form a layer. A reddish brown colouration at the interface was formed to show positive results for the presence of terpenoids (Tease and Evans, 2005).

Test for Anthraquinones: A portion (5 g) of each powdered sample was taken and boiled in 10 cm^3 of aqueous HCl and then filtered while hot. To the filtrate, 5 cm^3 of Chloroform was added before the mixture was thoroughly shaken. The Chloroform layer was pipette into another test tube and 2 cm^3 of 10% ammonia solution was added. A red colouration was observed in the lower phase which indicated the presence of anthraquinones.

Test for steroids: 2 cm^3 of acetic anhydride was added to 0.5 g of the plant sample each with 2 cm^3 of conc. H_2SO_4 acid. Presence of steroids is noted by the changing of colour from violet to blue (Harbone 1993; Trease and Evans 2005).

Test for Cardiac glycosides: (Killer-Killani Test). Portion (1 g) of the powdered sample was dissolved in 5 cm^3 of distilled water and 2 cm^3 of glacial acetic acid solution containing one drop of ferric chloride solution. This was underplayed with 1 cm^3 of concentrated H_2SO_4. A brown ring at the interface indicated the presence of deoxysugar characteristics of cardenolides. A violet ring appeared below the brown ring while in the acetic acid layer a greenish ring was formed just above the brown ring and gradually spread throughout this layer.

Quantitative Analysis of the Phytochemicals

Determination of Flavonoids: 2 grams of each of the samples were extracted repeatedly with 10 cm^3 of 80% aqueous methanol at room temperature. The mixture was filtered through Whatman No. 1 filter paper into a pre-weighed 250 cm^3 beaker. The filtrate was later transferred into a crucible and evaporated into dryness over a water bath and weighed to a constant weight.
(Krishnaiah *et al*., 2009).

Determination of Alkaloids: 5 grams of the sample were weighed into a 250 cm^3 beaker and 20 cm^3 of 10% acetic acid in ethanol was added and covered and allowed to stand for 4 h. This was filtered and the extract was concentrated on a water bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitate was collected and washed with dilute ammonium hydroxide and then filtered. The residue is the alkaloid, which was dried and weighed (Harborne, 1973).

Determination of Tannins: The sample extract (1 cm^3) was mixed with folin-coicalteaus reagent (0.5 cm^3), followed by the addition of saturated Na_2CO_3 solution (1 cm^3) and distilled water (8 cm^3). The reaction mixture was allowed to stand for 30min at room temperature. The supernatant was recorded by centrifugation and absorbance of standard tannic acid was prepared and the absorbance was recorded at 725nm using UV-visible spectrophotometer.

Determination of Saponins: Test extract was dissolved in 80% methanol and 2 cm^3 of Vanilin in ethanol was added and mixed well. 2 cm^3 of 72% sulphuric acid was added, mixed well and heated on a water bath at 60^0C for 10min. Absorbance was measured at 544nm against reagent blank. Diosgenin was used as a standard material and compared the assay with Diosgenin equivalents.

Determination of Total Phenol: Total Phenol was estimated by the method of folin-ciocalteau. To 0.4 cm^3 of the samples, 9 cm^3 of distilled water was added followed by 1 cm^3 of folin-ciocalteau reagent and shaken well. After incubating for 5 min, 10 cm^3 of 7% sodium carbonate was added to all the flasks. The volume was then made up to 25 cm^3 with distilled water and mixed well. Read the blue color developed at 750 nm after 90 min incubation at 23^0C. The amount of total phenol was expressed in milligrams of Gallic acid equivalents (GAE) per serving.

Proximate Composition

The proximate composition comprising of the moisture, ash, crude fiber and crude fat content were determined using the standard methods of Association of Official Analytical Chemist (2006). The total nitrogen content was determined using micro-Kjeldhl and converted to crude protein (N × 6.25) (Association of Official Analytical Chemist, 2000). Carbohydrate content was obtained according to Onwuka (2005) which was calculated as follows:

%Carbohydrate = 100 (% Moisture + % Ash+ % Protein + % Fiber).

Mineral Content Determination

The mineral constituents in the dried powdered flower samples were determined. For each sample, 2 g was digested with concentrated nitric acid and concentrated perchloric acid in the ratio 5:3 and the mixtures were placed on a water bath for three hours at 80^0C. The resulting solution was cooled and filtered in a 100 cm^3 standard flask which was then made to the mark with distilled water (Asaolu, 1995). Na, K, Ca, K, Fe, Mg, Zn, Pb and Ni were determined using Atomic Absorption Spectrophotometer (Bulk Scientific Model 2000A/200). (Essien *et al*., 1992) and their absorption values were compared with absorption data of standards of each of the metals.

RESULTS

Tables 1 and 2 present the results for the quantitative and qualitative phytochemical analysis of the three selected edible flowers obtained from Ekiti State, respectively. Nine out of ten phytochemicals investigated were detected in *M. oleifera* flower and *M. paradisiaca* bract. *H. rosasinensis* has only five phytochemicals.

Table 1. Qualitative phytochemical composition of flowers of *H. rosasinensis, M. oleifera* and *M. paradisiaca* bract

Phytochemicals/ samples	Fla.	Alk.	Tan.	Sap.	Phe.	Ter.	Phl.	Ant.	Car. Gly.	Ste.
H. rosa sinensis	-	-	-	+	-	-	+	+	+	+
M. oleifera	-	+	+	+	+	+	+	+	+	+
M. paradisiaca	+	-	+	+	+	+	+	+	+	+

Key: Fla.–Flavonoids, Alk.-Alkaloids, Tan.-Tannins, Sap.-Saponins, Phe.-Phenols, Phlob.–Phlobatannins, Ter.–Terpenoids, Ant.- Anthraquinone, Car. Gly.–Cardiac Glycosides and Ste.- Steroids. "+ " indicates presence, " - " indicates absence

Table 2. Quantitave phytochemical composition (mg/100g) of flowers of *H. rosasinensis, M. oleifera* and *M. paradisiaca* bract.

Phytchemicals/ Samples	Flavonoids	Alkaloids	Tannins	Saponins	Phenols
H. rosasinensis	-	-	-	63.03±1.14	-
M. oleifera	-	30.59±0.31	54.61±0.24	46.51±32.52	44.37±0.31
M. paradisiaca	17.98±0.28	-	48.93±0.14	25.42±0.26	36.09±0.28

Values are the mean of triplicates ± S.D

Table 3. Proximate estimation of flowers of *H. rosasinensis, M. oleifera* and *M. paradisiaca* bract.

	Car.	Cru. Pro.	Cru. Fat	Ash	Cru. Fib.	Moi. Con.
	Percentage composition (%)					
H. rosasinensis	61.11±0.13	1.90±0.03	4.67±0.15	2.64±0.08	17.27±0.03	12.37±0.24
M. oleifera	49.01±0.22	3.07±0.18	3.36±0.15	1.89±0.22	29.00±0.54	13.66±0.16
M. paradisiaca	50.59±0.17	1.97±0.07	5.60±0.03	3.34±0.12	25.54±0.60	12.95±0.17

Values are the mean of triplicates ± S.D

Key: Car.- Carbohydrate, Cru. Pro. - Crude protein, Cru. Fat - Crude fat, Cru. Fib. - Crude fiber, Moi. Con. - Moisture content

Quantitative estimation (mg/100g) showed that the three flowers were rich in saponins which ranged between 25.42 and 63.03. *M. oleifera* flower contained 30.54mg/100g alkaloids, 54.61mg/100g tannins, 46.51mg/100g saponins and 44.37mg/100g phenols while *M. paradisiaca* bracts contained 48.93mg/100g tannins, 25.42mg/100g saponins and 36.09 mg/100g. The result of the proximate composition of the three flowers is presented in Table 3. The value obtained for carbohydrate ranged from 49.01 to 61.11%, crude protein 1.90 to 3.07%, crude fat 3.36 to 5.60%, ash content 1.89 to 3.34%, crude fiber 17.27 to 29.00% and moisture content 12.37 to 13.66%. The mineral element present in the three flowers followed the order Sodium > Potassium > Calcium > Iron > Magnesium >Manganese > Zinc and Copper. Trace amount of Nickel were found in *M. oleifera* flower and *M. paradisiaca* bract while Cadmium was not detected in the three flowers investigated (Table 4).

Table 4. Mineral compositions of flowers of *H. rosa sinensis, M. oleifera* and *M. paradisiaca* bract.

	Amount detected in mg/100g		
	H. rosasinensis	***M. oleifera***	***M. paradisiaca***
Sodium	845.29	813.94	935.25
Potassium	404.81	437.55	395.17
Calcium	266.23	246.44	279.18
Magnesium	35.69	36.17	33.28
Manganese	18.58	15.74	28.67
Copper	3.86	4.04	4.14
Zinc	13.02	11.25	11.86
Iron	34.88	35.31	43.76
Nickel	ND	0.04	0.04
Lead	ND	0.03	0.02
Cadmium	ND	ND	ND

Values are the mean of triplicates and ND means not detected.

DISCUSSSION

Edible flowers of *H. rosasinensis M. oleifera* and the bract of *M. paradisiaca* were found to contain phytochemicals which are of medicinal values (Morton, 1987; Kasture *et al*., 2000; Berhovich *et al*., 2013). Different phytochemicals have been reported by several authors to possess a wide range of biological activities which may help in ameliorating or curing certain diseases (Cowan, 1999; Okwu, 2004; Ighinosa *et al*., 2009; Adinortey *et al*., 2012; Amin *et al*., 2013). Comparatively, the result of our findings on phytochemical composition of *M. paradisiaca* bracts agreed with the reported work of Adeolu and Enesi (2013) but disagree with the presence of alkaloids in their findings. Also, the findings in this research work concord with the results obtained for phytochemical screening of water extract of *M. oleifera* leaves (Kasolo *et al*., 2010).

The presence of tannins in *M. oleifera* flower and *M. paradisiaca* bracts implies that they have potential antibacterial, anti-inflammatory and antiviral properties (Adzouana and Mombouli, 2012). The availability of flavonoids in *M. paradisiaca* bracts is an indication that the bracts may have a significant pharmacological property that can modify the reaction of the human body to allergies, ulcers as well as anti inflammatory and antimicrobial activities (Cushine and Lamb, 2005; Abigail *et al*., 2012). The hepatoprotective activity of the flower of *M. oleifera* has been documented by Gilani *et al*. (1997). This is due to the presence of quercetin, a well known flavonoid in the flower. The flowers of the three plants investigated contained saponins. Saponins have been reported to have cholesterol binding properties (Sodipo *et al*., 2000). They also have curative effects on cancer and are known to boost immune system (Adeolu and Enesi, 2012). Tannins and Phenols were found to be present in high concentrations in both *M. oleifera* flower and *M. paradisiaca* bracts. The presence of tannins in them infers that they can be used for the treatment of intestinal disorders like diarrhea and dysentery. Tannins have been reported for its astringent, wound healing and anti-inflammatory properties (Farquar, 1996). Phenol is considered to have antimicrobial properties which in turn could make the edible flowers effective in the treatment of typhoid fever and other bacterial infections (Otofokansi *et al*., 2005). Other important bioactive compounds like terpenoids, phlobatannins and cardiac glycosides have been documented to have different pharmacological effects on man. Terpenoids and steroids have been reported to be effective against bacterial such as *Staphylococcus aureus* (Cowan, 1999). Cardiac glycosides have been used to treat congestive heart failure.

The nutritional profile of the edible flowers showed that their moisture contents are lower compared to other edible flowers. Percentage moisture content of 89.32, 83.39 and 81.74 has been reported for *Tropaelum majus*, *Tagetes erecta* and *Spilanthes oleracea* respectively (Navarro-Gonzalez *et al*., 2015). The low moisture content of the three investigated flowers suggests that they can be kept for some time without deterioration. They could also be useful in the dry season as an alternative soup ingredient when common leafy vegetables are not readily available. Their carbohydrate contents when compared to some vegetables like *Ceiba pentandra, Manihot esculentus* and *Abelmoschus esculentus* (Raimi *et al*., 2014) are higher and could be considered as a good source of energy. However, the values compared favourably with the 52.18% carbohydrate values reported for *Amaranthus asper* (Jimoh *et al*., 2010) and 54.3% *Cochorus olitorus* (Arowosegbe *et al*., 2015). The values obtained for ash in the study are low when compared with the values reported for *H. sabdariffa* (7.50%) and *Telfaria occidentalis* (8.54%) (Asaolu et al. 2012)

but comparatively higher than 0.83% and 0.55% reported for leaves of *Occimum gratissimum* and *Talinum fruticosum* respectively (Adeniyi *et al*., 2012) .The percentage crude fiber contents for the three flowers investigated are high when compared to the values reported for other foodstuff. The values are higher than that of *O. gratissimum* leaf (11.38%), *Melanthera scandens* leaf (12.66%) and *Lea guineensis* leaf (9.61%), (Faghohun *et al.*, 2011). High fiber concentration in the studied flowers could make them to be regarded as good sources of crude fiber. Adequate intake of dietary fiber has been reported to lower the serum cholesterol level, hypertension, cardiac disease, diabetes and constipation in human (Ishida *et al*., 2000).

The crude protein contents of the flowers investigated are lower when compared to the reported value of 11.47% for *M. paradisiaca* bract (Adeolu and Enesi, 2013) and 20.80% for *M. oleifera* leaf (Arowosegbe *et al*., 2015). However, these values are similar to those contained in the reports of Navarro-Gonzalez *et al*. (2015) for some edible flowers.

Crude fat contents of the flower samples in this study are moderate. The values are significntly more than what was reported for some edible flowers such as *I. majus*, *T. erecta* and *S. oleracea*. However, the values fall below the amount of crude fat reported for the leaves of *Myrianthus arboreus* (6.01%) and *Spargonophorus sporgonophora* (6.45%) (Oyeyemi *et al*., 2014). A diet providing 1.20% of its caloric energy as fat is considered to be sufficient for human being. Crude lipids are principal source of energy but should be consumed moderately so as to avoid obesity and other heart related diseases (Anita *et al*., 2016). Flowers like fruits are not very good sources of fats.

Minerals form the fundamental parts of enzyme systems and they help in prevention of many diseases and equally strengthen the human immune system (Campbell and Reece, 2006). The three edible flowers investigated in this study could be considered as excellent source of minerals when their mineral profiles are compared with some common leafy vegetables consumed in Nigeria. The mineral element composition is one of the most important factors that promote the use of edible flowers in human nutrition. The values of mineral element in our findings revealed high concentrations of potassium, calcium, magnesium and sodium. This result agreed with the work of Rop *et al.* (2012) but differs in low concentrations of Fe and Mn in their previous work. Sodium and potassium are important intracellular and extracellular cations, respectively. Food rich in K have been reported to help in prevention of cardiovascular and oncogenic diseases (Kader, 2008).

Calcium and phosphorus are very important in the formation of strong bones and teeth, blood clothing, heart function and cell metabolism (Rolte *et al*., 2009). The studied flowers contained iron needed in the hemoglobin formation, hence could be recommended for the treatment of iron deficiency (anemia). Manganese found in the flowers investigate was reported to activates many enzymes. Copper plays an important role in hemoglobin formation and also contribute to iron and energy metabolism (Adinortey *et al*., 2012). Zinc has been reported to be involved in normal functioning of immune system (Ibrahim *et al*., 2001) and also associated with protein metabolism.

CONCLUSION

The three selected edible flowers constitute an important source of naturally occurring phytochemicals and this may provide a basis to incorporate them into various health/food formulations. The results further indicate that the flowers are potential sources of carbohydrate, dietary fiber and essential minerals which could be utilized in food science. Flowers which are regarded as waste could become wealth if their rich medicinal and nutritional values are properly harnessed.

Declaration of Conflicts of Interest

The authors declared that no competing interest exits.

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