CHEMICAL COMPOSITION, ANTINUTRIENT CONTENTS AND FUNCTIONAL PROPERTIES OF *Corchorus olitorius* and *Melochia corchorifolia*

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M.M. Ndamitso[1], M.M., M.Jagaba[1], J.I. Musah[2*], A. Mann[1], E.B. Mohammed[1]and A. Umar[2]
[1]Department of Chemistry, Federal University of Technology, Minna, Nigeria
[2]Department of Chemistry, Niger State College of Education, Minna, Nigeria
*Corresponding author: musahmonday@yahoo.com

Abstract: The comparative nutritional values of *Corchorus olitorius* and *Melochiaorchorifolia* were determined using standard analytical methods. The results were discussed using the T-test atp≤0.05.The proximate parameters determined were moisture, ash, protein, fat and carbohydrate. The respective values of ash (14.4±0.20%), crude protein (8.58±0.02%), crude fibre (2.05±0.23%), protein density (9.31±0.08) and fat density (9.31±0.08%) for *C. olitorius* were higher than the 12.71±0.17, 6.09±0.21, 1.65±0.04, 6.77±0.15and 25.99±1.69% respectively obtained for *M. corchorifolia*. On the other hand, the respective moisture (10.71±0.01%), fat (24.82±1.30%) and carbohydrate density (66.83±1.47) for M. *corchorifolia* were higher than the 10.23±0.06 ,12.61±0.02 and 59.51±0.09% recorded for *C. olitorius*. The sodium and potassium contents of the samples were determined using flame photometer model FP6410 while other minerals were determined using atomic absorption spectrophotometer (AAS) Model: Accusy 211. With exception of potassium, *M. corchorifolia* had higher mineral contents than *C. olitorius*. Functional properties were determined using standard analytical methods. The values of wettability, emulsifying capacity and gelation capacity for *M. corchorifolia* were higher than those of *C.olitorius*. However, the bulk density, foam capacity and water absorption capacity of *C. olitorius* were higher than those of *M. corchorifolia*. The amino acids profile was determined using Technicon Sequential Multi-sample Amino Acid Analyzer (TSM) and except histidine and aspartic acid, *M. corchorifolia* had higher values of the remaining amino acids which made the ratio of essential amino acids to non essential amino acids in *M. corchorifolia* to be higher than that of *C. olitorius*. In addition, *C. olitorius* had higher values of antinutritional factors.

Keywords: Nutrition, proximate, amino acids, minerals, cyanide, saponin.

Introduction

Vegetables play important roles in human diets. They supply the body with minerals vitamins and certain hormone precursors in addition to protein and energy (Ndlovu and Afolayan, 2008). Despite the consumption of exotic vegetables, some indigenous vegetables have been reported to be *more* nutritious and less expensive than the exotic ones. *Corchorus olitorius L*., commonly known as wild okra, belongs to the family *Tiliaceae*. It is widely consumed as a vegetable among rural communities in most parts of Africa. In West Africa, it is commonly cultivated and very popular among people of all classes especially in Nigeria (Oyedele, 2006).

The plant is also eaten in some parts of Asia (Ndlovu and Afolayan, 2008). *Corchorus olitorius* is known to contain high level of iron and folate which are useful for the prevention of anemia (Oyedele, 2006). Ecologically, the crop grows more easily in rural subsistence farming systems when compared to exotic species like cabbage and spinach (Modi and Hendriks, 2006). *Melochia corchorifolia* Linn (also known as Tukurwa in Hausa) is a weed of moist or hydromorphic environment, with an erect or prostrate bushy pale brown hollow stem (Umar *et al.*,2007). It is an herbaceous perennial with erect or prostrate bushy stem attaining a height of 1m. This plant is used as soup ingredient and also in the traditional treatment of various skin diseases and itching among local Gbagyi people.

Corchorus olitorius Linn (known as Ayoyo among Hausas)is widely consumed as a vegetable among rural communities in most parts of Africa and some parts of Asia for its viscous leaves (Van vuuren, 2006; Ndlovu and Afolayan, 2008). These leaves are used either fresh or dried and are a rich source of vitamins and minerals (Modi and Hendriks,2006). The stem bark of this plant is also used as a rich source of fibre in some West African countries like Ghana, Nigeria, and Sierra Leone. Its leaf extracts have also been used in ethnobotanical medicine for the treatment of fever, pains, gonorrhoea, chronic cystisis, anaemia and tumors (Ndlovu and Afolayan, 2008).Though both plants (*Corchorus olitorius* and *Melochia corchorifolia*) are consumed in the same manner, have the same taste when prepared as soup, they may not have the same nutritional advantage. Despite the use of *Melochia corchorifolia* as food especially by the Gbagyis, no comprehensive report is available in literature on their nutritional values (Umar *et al.*, 2007). This study seeks to investigate the nutritional value of *Corchorus olitorius* and *Melochia corchorifolia*.

Materials and Methods

Samples of freshly harvested *Corchorus olitorius* used in this work were purchased at five different markets: Bosso Maikunkele, Paiko, Maitumbi and Gwada markets of Niger State. They were properly washed and taken to the Biological Science Department of the Federal University of Technology Minna for identification while the samples of *Melochia conchorifolia* were collected from wild from the localities mentioned above and were taken to the Biological Science Department, Niger State College of Education for identification. They were both authenticated by Abdullahi Mann of Chemistry Department, Federal University of Technology, Minna, Nigeria.

Preparation of samples

The leaf samples were washed in water contained in basin and destalked manually. The leaves were spread on polyethene bags, dried at ambient temperature in the Chemistry laboratory for three weeks. The dried leaves were pounded using porcelain mortar with pestle, sieved using 250 μm mesh sieve and stored in plastic containers for further use.

Evaluation of proximate composition

The residual moisture content was determined by drying 5g of each powdered sample (in triplicate) in a Gallenkamp oven at 105°C until constant weights were obtained (AOAC, 2010). Ash content was determined according to the method described by Ceirwyn (1998). This involved drying in muffle furnace at 600°C until greyish white ash was obtained. Crude protein was determined as described by the AOAC (2010) methods using nitrogen conversion factor 6.25 recommended for vegetable products (Bernice and Merril, 1975). Crude fibre was determined by method of AOAC (2010). Energy value, protein and fat densities were determined using expressions described by Asibey-Berko and Taiye (1999).

Determination of mineral composition

Each sample (1.0 g) was weighed in triplicate into porcelain crucibles and ashed at 500°C in a furnace. The ashed samples were wetted with drops of water and 3cm^3 of HNO_3 carefully added. Excess HNO_3 was evaporated on a hot plate set at 110°C. The crucibles were then heated in the furnace for 1 h at 500°C. The crucibles were allowed to cool and the ashes were dissolved in about 40cm^3 of 0.1 moldm^{-3} HCl and filtered into100 cm^3 volumetric flasks and made up to the mark. The filtrates were transferred into sample bottles and kept for further analysis (Gregory, 2005).The minerals were determined spectrophotometrically using Atomic Absorption Spectrophotometer but sodium and potassium were analysed using Flame Emission Spectrophotometry (Ceirwyn, 1998).

The contribution of *Corchorus olitorius* and *Melochia corchorifolia* Linn to dietary intake of essential elements was evaluated using the expression reported by Hassan *et al.* (2005):

$$\text{Contribution to RDA (\%)} = \frac{Concentrations\,(mg/100g)}{RDA} x100$$

Where: RDA = Recommended dietary allowance.

Determination of functional properties

Bulk density was determined by gently filling 10cm^3 graduated measuring cylinder with the sample and its bottom was gently tapped until the volume of the sample stopped decreasing (Yoshiyuki and Yukata, 2003). Emulsification capacity was determined by adding groundnut oil to the blended samples and centrifuged at 1600 rpm for 5min (Idris and Yisa, 2009) while water absorption and foam capacities were determined using methods described by Abbey and Ibey (1988). The time required for the samples to become completely wet (wettability) and gelation capacity were determined by method described by Gregory (2005).

Determination of amino acids

The amino acids profiles of the leaf samples were determined using methods described by Imura and Okada (1998) with modifications described by AOAC (2010). The leaf samples were defatted, hydrolysed, evaporated in a rotary evaporator and loaded into the Technicon sequential multi-sample Amino Acid Analyser (TSM).

Determination of antinutrients

Oxalate content was determined according to the method described by Day and Underwood (1986). Phytate content was determined by method of Gutteridge and Shelton (1998) which involved centrifuging of extracts of the samples and subsequent measurement of absorbance. Cyanide and tannins were determined by methods in AOAC (1990).

Results and Discussion

Proximate composition

The proximate compositions of the leaf samples are presented in the Table1. The moisture contents were 10.23±0.6 and 10.7±0.01% for *Corchorus olitorius* and *Melochia corchorifolia* respectively. These values however, were lower than the 62.16±11% reported by (Umar *et al.*, 2007).Variations in moisture contents are generally associated with different drying periods and the methods of processing of vegetables (Ogbonnaya and Bosede, 2011). However, the low moisture contents of these samples would afford good quality reducing microbial spoilage for a reasonable period of time. The ash contents of *C. olitorius* and *M. corchorifolia* were 14.41±0.20 and 12.71±0.17, respectively. This variation in the ash content could be due to differences in ages of the vegetables and the environmental conditions under which they were grown (Firman *et al.*, 1991). The protein contents of *C. olitorius* and *M. corchorifolia* were 8.58±0.02 and 6.09±0.21%, respectively. These values however, were lower than the 36.23±0.23% reported for 'Eri' by Ogbonnaya and Bosede (2011) for soyamilk bye products. The fat contents of *Corchorus olitorius* and *Melochia corchorifolia* which were 12.62 ± 0.02 and 24.82 ± 3.31%, respectively differed significantly ($p \leq 0.05$).

The crude fibre contents of the plants were 2.05±0.23 and1.65±0.04% for *C. olitorius* and *M. corchorifolia* respectively which were significantly differed at $p \leq 0.05$ but were lower than the 7.33± 0.95% reported for Eriby Ogbonnaya and Bosede (2011). The respective calorific values of 1532.20±0.44 and 1492.90±0.38kcal/100g for *C. olitorius* and *M. corchorifolia* also differed significantly at ($p \leq 0.05$).

Table 1: The results of the proximate compositions of *Corchorus olitorius* and *Melochia corchorifolia*linn

Parameters	***Corchorus oliforus***	***Melochiacor chorifolia***
Moisture (%)	10.23±0.06	10.71±0.01
Ash (%)	14.41±0.20	12.71±0.17
Protein (%)	8.58±0.02	6.09±0.21
Crude fibre (%)	2.05±0.23	1.65±0.04
Fat (%)	12.61±0.02	24.82±0.31
Calorifc value (k/100g)	1532.20±0.44	1492.90±0.38
Protein density (%)	9.31±0.08	6.77±0.15
Fat density (%)	30.88±0.00	25.99±1.69
Carbohydrate density (%)	59.51± 0.09	66.83±1.47

Values presented as mean of triplicate values ± standard deviation

Mineral content

The selected mineral contents of *C. olitoriu* and *M. corchorifolia* are presented in Table 2. The sodium contents of both *C. olitorius* and *M. corchorifolia* did not differ significantly ($p \geq 0.05$). The sodium content of 91.43±1.49 and 92.17± 1.70mg/100g for *C. olitorius* and *M. corchorifolia* were lower than the 195.00mg/100g reported for *H. sabdariffa* by Ladan (1996). The consumption of 100g of either *C. olitorius* or *M. Corchorifolia* will provide about 18% of the dietary requirement of this element. For males and females between 9 and 50 years, 1500mg of sodium has been recommended as an adequate intake while after the age of 50 years, 1300mg is considered adequate (Carol, 2011). Therefore, consumption of 100g of either of these plants would contribute about 6 and 7% of the recommended adequate amounts of sodium for the respective age groups.

The phosphorus *C. olitoriu* and *M. corchorifolia* were 62.60±0.79 and 67.57±2.49mg/100g, respectively. This variation could be as a result of differences in the types of plant, ages and environmental conditions in which the crops were grown (Joseph, 1997). The calcium contents were 173. 82±1.48 and 177.20 ±1.70mg/100g for *C. Olitorius* and *M. corchorifolia*, respectively. The consumption of 100g of either of these plants daily will contribute about 9% of the required calcium per day.The levels of potassium of 931.03±1.37 and 1140.50±2.18 mg/100g for *M. corchorifolia* and *C. olitorius* respectively differed significantly but were less than the 2722.0.05±0.22mg/100g reported for *M. oleiferra* by Idris *et al.*(2009). High intake of potassium is known to prevent rise in blood pressure and is also required for normal tissue protein synthesis in protein depleted animals (Ogbuagu *et al*., 2011; McDonalds *et al*., 1987).

The levels of magnesium were 436.37±3.75mg/100g and 444.80±1.58mg/100g for *C. olitorius*and *M. corchorifolia*, respectively which differed significantly at p≤0.05. These values were higher than the 380.60±116.8mg/100g reported for *Corchorus tridens* but lower than the 450.6 ±126.2 mg/100g reported for *Moringer oleifera* by Barminas *et al.* (1998).Dietary deficiencies of magnesium which is linked with ischemic heart disease could be prevented by regular consumption of these vegetables in the indigenous diet since the consumption of 100g of *C. olitorius* will contribute 124.68±1.07% of the daily requirement of the element while *M. corchorifolia* will contribute 127.08±1.22% (Ogbuagu *et al*., 2011).

The zinc content of *C. olitorius* was 25.01±0.95 while that of *M. corchorifolia* was 28.57±0.59mg/100g. These values differed significantly at p≤0.05. These values were higher than that of Jew's mallow (12.40±0.72 mg/100g) as reported by Barminas *et al.* (1998). Regular consumption of these vegetables may assist in preventing the adverse effects of zinc deficiencies which results in retarded growth and delayed sexual maturation (Barminas *et al.*, 1998).The values of copper obtained were 4.99±0.06mg/100g for *C. olitorius*and 6.26±0.34mg/100g in *M. corchorifolia*whichwere higher than the1.8±1.2 reported for *Casiatora*by Barminas*et al.*, (1998). They were however lower than the 33.50±2.55mg/100g reported for *M. corchorifolia* byUmar *et al.* (2007). Copper is required in haemoglobin formation (Ishida *et al*., 2000).

The respective iron content of the samples were 24.56±0.42 mg/100g and 40.99±0.89 mg/100g for *C. olitorius*and *M. corchorifolia* and these values differed significantly (p≤ 0.05). They were higher than the 8.94mg/100g reported for *Brassica oleraceae* by Emebu and Anyika (2011). Iron is important in the diet of pregnant and nursing mothers as well as infants, the convalescent and elderly (Barminas *et al.*, 1998). The consumption of 100g of *C. olitorius* or *M. corchorifolia* will contribute 163.73±2.8 or 273.25± 5.94% of the RDA of this element showing that both are good sources of this element although, the latter contributes more to the RDA than the former.

Table 3 shows the result of the contribution of each plant to the recommended dietary allowances of the analysed minerals. While the contribution to RDA values of sodium and phosphorus by the two plants showed no significant difference, the contributions to the RDA values of the remaining elements differed significantly (p ≤ 0.05) and these showed that the two plants could be good sources of most of the elements especially magnesium and the other micro elements determined in this study.

Table 2: The selected mineral compositions of *Corchorus olitorius* and *Melochia corchorifolia* (mg/100g)

Parameters	*Corchorus oliforus*	*Melochiacor chorifolia*
Sodium	91.43±1.49	92.17±1.70
Phosphorus	62.60±0.79	67.57±.49
Calcium	173.82±1.48	177.20±1.70
Potassium	1140.50± 2.18	931.03±1.37
Magnesium	436.37±3.75	444.50±1.58
Zinc	25.01±0.95	28.57±0.59
Copper	4.99± 0.60	6.26±0.34
Iron	24.56± 0.42	40.99±0.89
Manganese	8.54±0.45	12.30±0.55

Values presented as mean of triplicate values ± standard deviation

Table 3: The percentage contribution of each plant to the RDA of each mineral analyzed

Parameters	RDA Value	*Corchorus oliforus*	*Melochiacor chorifolia*
Sodium	500	18.29± 0.28	18.43±0.34
Phosphorus	1200	5.26±0.04	5.11±1.37
Calcium	1200	8.70±0.08	8.92±0.03
Potassium	2000	95.07±0.13	77.19±0.95
Magnesium	350	124.68±1.07	127.08±1.22
Copper	1.5-3	166.47±19.93	208.67±11.21
Iron	10-15	163.73±2.81	273.25± 5.94
Manganese	2-5	172.80±9.34	244.40± 11.52
Zinc	12-15	208.38±7.95	238.07 ±4.91

Values presented as mean of triplicate values ± standard deviation

Functional properties

Table 4 shows the functional properties the two plants analyzed. The wettability, emulsifying capacity and gelation capacity for *Melochia corchorifolia* were significantly different from those of *Corchorus olitorius* atp≤ 0.05. However, the bulk density, foam capacity and water absorption capacity of *Corchorus olitorius* differed significantly from those of*Melochia corchorifolia*at p≤ 0.05.

Table 4: The functional properties of *Corchorusolitorius* and *Melochia corchorifolia*

Parameters	*Corchorus oliforus*	*Melochia corchorifolia*
Bulk density (%)	0.49±0.01	0.63±0.1
Wettability (minutes)	120.00±0.00	240.00±0.00
Foam capacity (%)	14.04±0.50	11.68±2.17
Water absorpt. Capcity (%)	4.02±0.06	2.04±0.05
Emulsion capacity (%)	61.08±005	64.00±0.01

Values presented as mean of triplicate values ± standard deviation

Amino acids

The values of essential amino acids contents of the two plants in this study were as presented in Table 5. Six essential amino acids: histidine, lysine, valine, leucine, arginine and methionine obtained for the plants differed significantly (p ≤ 0.05) while the remaining three: isoleucine, phenylalanine and tryptophan did not.The respective values for *C olitorius* are histidine (2.16±0.09), lysine (3.93±0.06), valine (3.74±0.13),leucine (4.97±2.18), arginine (4.87±0.13) and methioni (0.87±0.04) and *M. corchorifolia:* (1.94±0.04), (4.05±05), (4.42±0.26), (4.42±0.26), (4.42±0.2) and (1.19±0.08). Regular consumption of these plants would be of great nutritional values as they are essential in the breaking down of foods, growth and repairs of tissues.Table 5 showed that the lysine, histidine, arginine, alanine, cystine and valineof the two plants differed significantly (p≤0.05) while other amino acid content did not differ *(*p≤0.05). The histidine and aspartic acid of *Corchorus olitorius* showed significant difference at p≤0.05 from those of *Melochia corchorifolia*. Threonine, serine, glutanic acid, proline, gycine, methionine, phenylalamine and tryptophan values of both samples showed no significant difference.

Table 5: The amino acids profile (g/100g of protein) of *Corchorus olitorius* and *Melochia corchorifolia*

Parameters	*Corchorus oliforus*	*Melochia corchorifolia*
Lysine	3.93±0.06	4.05±05
Histidine	2.16±0.09	1.94±0.04
Arginine	4.87±0.13	4.42±0.26
Aspartic acid	9.23±0.05	8.60±0.09
Threonine	3.13±0.14	3.37±0.21
Serine	2.25±0.24	2.40±0.19
Glutanic acid	7.34±0.32	7.55±0.37
Proline	2.69±0.36	2.85±0.50
Gycine	3.43±0.38	3.28±0.18
Alamine	3.06±0.34	3.34±0.13
Cystine	5.99±0.75	7.74±0.15
Valine	3.74±0.13	4.42±0.26
Methionine	0.87±0.04	1.19±0.08
Isoleucine	3.55±0.20	9.95±13.51
Leucine	4.97±2.18	4.42±0.26
Tyrosine	2.54±0.18	2.86±0.24
Phenylalamine	3.56±0.36	4.31±0.36
Trypthophan	0.58±0.12	0.82±0.10

Values presented as mean of triplicate values ± standard deviation

Table6: The antinutritional factors of *Corchorus olitorius* and *Melochia corchorifolia*

Parameters	*Corchorus olitorius*	*Melochia corchorifolia*
Cyanide mg/100g	10.04±0.24	1.09±0.04
Phytate mg/100g	22.37±0.29	23.78±1.33
Tannin %	0.03±0.00	0.06±0.00
Oxalate mg/100g	4.04±1.71	3.55±3.32
Saponin %	9.43±0.16	7.85±1.56

Values presented as mean of triplicate values ± standard deviation; ***** = the difference is significant at p≤0.05

Antinutritional values

The antinutritional factors contents of these vegetables are presented in Table 6. The cyanides, tannins, oxalates and saponnins contents of the vegetables differed significantly (p≤0.05), while phytates did not differ significantly (p≤0.05). The respective phytate, tannin, oxalate and saponin contents of *C. olitorius* and *M. corchorifolia* are cyanides (1.52±0.01% and1.09±0.04%), phytates (22.37±0.29mg/100g and 23.78±1.33mg/100g), oxalates (4.04±1.71% and 3.55±0.32%) saponnins (9.43±0.16% 7.85±1.56%). Tannin values for *C. olitorius* (0.03±0.00%) and *M. corchorifolia* (0.06±0.00%) are lower than 21.19±0.25% reportedby Oyedele *et al.* (2006).

Conclusion

Corchorus olitorius and *Melochia corchorifolia* Linn are plants with great nutritional advantages to human body.From the results of this study, these vegetables are rich in ash and minerals like iron, zinc, copper and magnesium. They also contain essential amino acids which indicate their usefulness in body growth and repairs of tissues. They were also found to have good functional properties such as wettability, gelation property, water absorption capacity and emulsion capacity which indicate their suitability in viscous foods like soups.

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