

Association Between Proximate and Physicochemical Contents in Nigeria *Corchorus olitorius* L. (West African sorrel)

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Date Received: 27-02-2022

Date Accepted: 24-04-2022

DOI: <https://doi.org/10.48198/NJPAS/22.A05>

ABSTRACT

Despite the availability and consumption of jute mallow in most communities, there is little or no awareness of its nutritional values. Consequently, it is essential to establish its constituents for more awareness in alleviating food shortages. Association of Analytical Chemists procedures were used to ascertain its constituent. Variations and similarities were observed among the accessions studied. NG/OA/JUN/09/001 contained the least value in potassium, sodium, and phosphorus while NG/OA/02/11/008 was estimated with the highest in potassium ions. NG/SA/DEC/07/0403 and NHGB/09/147 had the same proportion of 0.340 in calcium ions while NG/SA/DEC/09/0403 documented the highest in calcium components, however; the NHGB/09/145 had the minimum value. The highest composition of sodium was established in NG/AA/06/12/177 while NG/AA/SEP/09/173 was documented for the highest value in phosphorus. NHCo-2 contained the highest composition in iron while NG/AA/SEP/09/173 recorded the smallest composition. Diversity recorded could be as a result of environmental influences or otherwise. The results suggested that the understudy vegetable contain all the vital nutrients necessary for human growth and development hence, highly recommended in developing countries to enhance food security.

Keywords: *Corchorus olitorius* L., African Sorrel, Phytochemicals, Variation, and Food Security.

Introduction

Corchorus olitorius L. is believed to have its origin in both tropical and subtropical regions of the World. Its common names include but are not limited to 'Ewedu' in Yoruba, 'Ahihara' in Igbo, and 'Malafiya' or 'Rama' in Hausa. It is the most frequently cultivated vegetable however, the existence of wilder species in Africa leads to larger genetic variation with *C. olitorius* L. indicating Africa as the first center of origin of the genus, with a secondary center of diversity in the Indo-

Burmese region (Roy *et al.*, 2006 and Jennifer, 1990). Presently it's being cultivated in tropical Africa as the major leafy vegetable in Cote d'Ivoire, Benin, Nigeria, Cameroon, Sudan, Kenya, and Zimbabwe (Makinde *et al.*, 2009).

Jute Mallow or Egypt spinach occasionally called West African sorrel or bush okra is a fibrous angiosperm in the family Malvaceae, formerly Tiliaceae, and of recent Sparrmanniaceae. *Corchorus* has been classified into numerous

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families such as Capparaceae, Cistaceae, Papaveraceae, and Tiliaceae (Whitlock *et al.*, 2003). Only 30 species are cultivated in Africa out of the 40-100 available species (Makinde *et al.*, 2009). Bush okra is one of the major fiber-based crops in the World, especially in the Indian subcontinent (Basu *et al.*, 2004). The most common types are 'Amugbadu', which grow tall, with large, oblong, and finely serrated leaves, and 'Oniyaya', which is broadly branched; with deep, broad and irregularly serrated leaves (*C. incisifolus*) and highly mucilaginous (National Horticultural Research Institute, Ibadan Prota-NIHORTPROTA Nigeria, 2002). In Cameroon and other West African countries, several local types are differing among others in height, stem colour, leaf, and fruit shape. 'Oniyaya' in Cameroon is more deeply lobed than those in Nigeria though there are overlaps. A large, broad-leaved accession from Cameroon with shorter swallowtails that are commonly cultivated near Yaoundé is called Greant de Bertoua. Its leaf tips are rounder than those of 'Amugbadu', the most common one in Nigeria, which resembles the Cameroonian Ewondo (Pal *et al.*, 2006). There are several other minor local morphotypes, for example, 'Eletiehor' with small ovate leaves-the ear of a hare, oblong and with fine serration, and 'Etieku' with a leaf shape like the ear of a rat. Another Accession is 'Yaga' (Makinde *et al.*, 2009).

It is all seasoned plant once the required conditions are met and perform best during hot and rainy weather. It grows well on sandy loam soils rich in organic matter or grassland and fallow or abandoned fields, usually close to rivers, lakes, and marshes. In Nigeria, the photoperiod essential for effective vegetative growth in weight of roots, stems, and leaves is 12.5hours while 11.5hours of day length is necessary for higher fruit and seed output.

Chweya and Eyzaguirre (1999) observed that critical investigation of genetic transformation in several African indigenous leafy vegetables,

including *C. oltorius* L., would aid early and adequate exploitation of the desirable dietary properties.

The genus has contributed greatly to the ecosystem in numerous ways (Chattopadhyay *et al.*, 2004 and NIHORTPROTA, 2002), such as health (Duke and Wain, 1981; Hillocks, 1998); Phytochemical analysis has been reported to be very useful in analyzing antioxidants used in treating malaria (Hillocks, 1998 and Ayoola *et al.*, 2008), antibacterial properties (Pal *et al.*, 2006); plants materials boosting human health as well as fodder (Ali, 2012), screening of medicinally active and important secondary metabolites in numerous plants as in *Anabasis aphylla* (Abollfazzl *et al.*, 2012), anti-inflammatory and active components of drugs in *Garcinia kola* (Adesuyi, *et al.*, 2012) and identification of secondary metabolites in Nimoalasis for remediation of pains, rheumatism, insomnia and headache (Aina and Wada, 2012). *Corchorus* is well known for its Ayurveda use (James Duke, 1983).

According to FAO, 1972 100g fresh jute leaves contains Water (84.1ml), Energy (43.0KJ), Protein (5.6g), Fat (0.3g), Carbohydrates (7.6g), Fiber (1.7g), Calcium (266.0mg), Phosphorus (122.0mg), Thiamin (0.13mg), Iron (7.7mg), Riboflavin (0.26mg), Beta-carotene (7850µg), Niacin (1.10mg), and Ascorbic acid (53mg).

Regardless of jute importance, inadequate attention is given to its improvement. Thus, it is necessary to evaluate critically the species of different accessions understudy to identify the best accession suitable for higher nutrition value in this locality by evaluating the chemical and proximate composition.

Materials and Methods

Source and selection of materials

Seeds were collected from NIHORT-National Horticultural Research Institute and IAR&T-Institute for Agricultural Research and Training Ibadan, Nigeria, and grown at the University of Ilorin Biological Science Research Farm. The fresh

and diseased free leaves of each accession were harvested for the analysis. For the vitamins, the plant's fresh leaves were extracted by soaking with warm water overnight for proper extraction while for other constituents, fresh leaves weighed (50g) at room temperature were used. The chemical and proximate analysis was carried out at the University of Ilorin, Chemistry Department. The calculation was done using the Association of Analytical Chemists (AOAC) 1995 procedures.

Proximate screening

Estimation of Vitamin C:

About 25ml of the leaves was extracted using water and made up in a standard flask. This was pipetted into a conical flask and the following chemicals were added respectively; 25ml of 0.01m KIO₃ (Potassium iodate), 2ml of 10% KI (Potassium iodide), add 10ml of 0.5m H₂SO₄ (Sulfuric acid). This was then titrated to give pale yellow colour and 3 drops of the starch indicator were added. This was done continuously until the solution changes from blue to colourless. The concentration was calculated as below:

$$\text{Vitamin C mg/100g} = \frac{\text{Titer value} \times 0.212 \times 100}{\text{Weight of sample (50g)}}$$

Determination of Vitamin A:

The sample was homogenized and saponified; ethanolic KOH (Potassium hydroxide) was then added for 30 minutes and then transferred to a separating funnel. This was repeatedly washed with an equal volume of water and filtered using filter paper containing 5g of Na₂SO₄ (Sodium sulfate). The mixture was rinsed with hexane and made up to the required volume (at a ratio of 1:1.5). The hexane was evaporated and 1ml of chloroform was introduced to the tin chloride (SnCl₂) solution.

Calculation:

$$\text{Vitamin A/g} = A_{620} \times \text{SL} \times \frac{V}{\text{WT}}$$

Assessment of Crude fiber:

Sample of 2g was weighed and defatted with petroleum ether for 2hours, boiled under reflux for exactly 30 minutes with 200cm³ of 1.25% H₂SO₄(Sulfuric acid), and filtered. Thereafter, washing was done with boiling water until the washings are no longer acidic. The residue was boiled in a round flask with 200cm³ of 1.25%NaOH for 30 minutes, filtered into a crucible with a known weight, and oven-dried at 100°C. This was left in a desiccator to cool and then weighed. The weighed ingredient was incinerated in a muffle furnace at about 600°C for 3hours, cool in a desiccator, and weighed. The calculation was done as follows:

$$\% \text{ Crude fibre} = \frac{\text{Mass of fiber}}{\text{Mass of original sample}} \times 100$$

Mass of original sample

Mass of fibre= weight of the filtered sample before incineration in a muffle furnace

Mass of original sample= weight of the filtered sample after incineration in a muffle furnace

Determination of fat, protein, and ash:

The milled leaves were dried to constant weight and the fat was extracted using ethanol-acetone. The protein was estimated on the defatted sample. Then the sample was ashed to determine the ash percentage.

Estimation of Carbohydrate:

A powdered sample of 0.1g was measured into a beaker and 20ml of distilled water was added. Then placed in a water bath for over five minutes and filtered for the test (Molisch's test). 2ml of the filtrate was introduced into a test tube and two drops of α-naphthol were added. The tube was slanted and concentrated H₂SO₄ was added down the side of the tube without mixing.

Estimation of moisture content:

The moisture was quantified by summing up the value of fat, crude fiber, protein, ash, and

carbohydrate and deducting from 100{100- (fat + crude fibre + protein + ash + carbohydrate)} %.

Phytochemical screening

The chemical contents were discovered through the digestion method for all the varieties.

About 2grams were digested using the Aqua regia method. Then 3ml of Nitric acid and 1ml of Hydrochloric acid were introduced to each sample. The flask was heated until the content was completely digested into a clear solution. This was removed from the heat and allowed to cool. The filtrate was reconstructed to 25ml. The elemental ions were then analyzed using an Atomic Absorption spectrophotometer (AAS) (AOAC 1995).

Results

The estimated values of proximate and phytochemicals in all the accessions studied indicate similarities and diversity (Tables 1 and 2). The results indicated that the accessions are linked, for instance, crude fiber, moisture content, and vitamin C are negatively related to protein and vitamin A. Likewise, protein has a strong positive association with crude ash as carbohydrate is to fat hence, each sector is negatively associated with the other and a positive relationship exists within each sector(fig.1). The physicochemical result is similar to that of the proximate analysis in the relationship among all the accessions. The combined principal component signified that there is a great link between the nutrients and chemicals present in Nigeria bush okra (fig. 2).

Table 1: Proximate screening of the *Corchorus olitorius* L. accessions studied.

Accessions	Vitamin A (mg/l)	Vitamin C (mg/l)	Fat (%)	Crude fiber (%)	Protein (%)	Carbohyd rate (%)	Ash (%)	Moisture (%)
NG/OA/JUN/09/001	0.94	27.13	0.030	1.66	11.40	36.50	21.00	29.44
NG/SA/DEC/07/0403	0.95	27.10	0.031	1.67	11.60	40.12	21.10	25.48
NHGB/09/147	0.98	26.31	0.032	1.65	12.20	44.50	21.30	20.32
NG/SA/DEC/09/0403	0.96	26.48	0.031	1.55	12.10	45.60	21.20	19.42
NG/AA/06/12/177	0.99	26.49	0.032	1.47	11.70	44.30	21.15	21.35
NHGB/09/145	0.94	26.51	0.031	1.52	11.80	43.52	21.18	22.19
NHCo-2	0.97	27.06	0.030	1.58	12.01	42.51	21.22	21.64
NG/OA/02/11/008	0.95	27.11	0.032	1.56	12.10	44.14	21.35	22.45
NG/To/02/12/179	0.98	27.13	0.031	1.55	12.15	44.08	21.30	20.83
NG/AA/SEP/09/173	0.92	27.10	0.032	1.57	12.14	43.42	21.15	21.06
NG/To/02/12/180	0.91	26.50	0.030	1.67	12.18	41.62	21.25	21.15

Table 2: Phytochemical screening of *Corchorus olitorius* accessions studied

Accessions	Potassium (mg/l)	Iron (mg/l)	Sodium (mg/l)	Phosphorus (mg/l)	Calcium (mg/l)
NG/OA/JUN/09/001	0.570	0.221	0.240	0.252	0.331
NG/SA/DEC/07/0403	0.580	0.227	0.244	0.258	0.340
NHGB/09/147	0.575	0.228	0.246	0.257	0.340
NG/SA/DEC/09/04031	0.579	0.230	0.248	0.256	0.341
NG/AA/06/12/177	0.576	0.229	0.250	0.257	0.338
NHGB/09/145	0.572	0.228	0.249	0.256	0.314
NHCo-2	0.580	0.237	0.245	0.258	0.315
NG/OA/02/11/008	0.585	0.229	0.244	0.254	0.326
NG/To/02/12/179	0.572	0.228	0.246	0.255	0.332
NG/AA/SEP/09/173	0.571	0.215	0.245	0.259	0.318
NG/To/02/12/180	0.575	0.226	0.242	0.257	0.319

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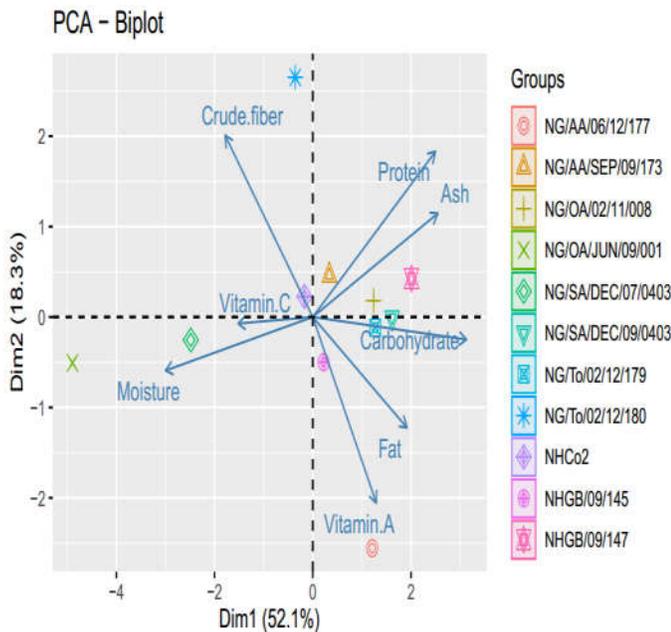


Figure 1: Principal component analysis of the relationship that exists between the proximate parameters of *Corchorus olitorius* and the accessions.

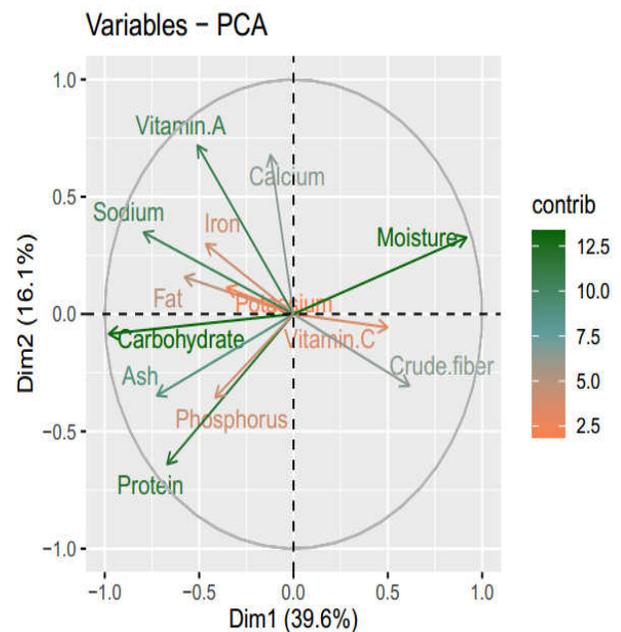


Figure 2: Principal component analysis of the relationship that exists between the Proximate analysis and physicochemical parameters of *Corchorus olitorius* showing the contributions of each variable.

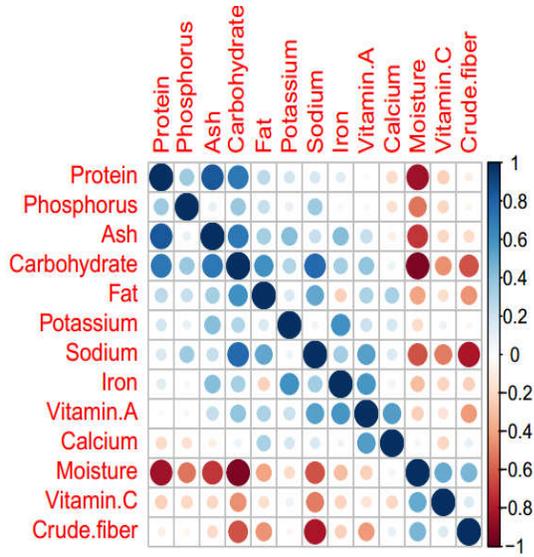


Figure 3: Correlation plot analysis of the relationship that exists between the proximate parameters and physicochemical parameters of *Corchorus olerius*.

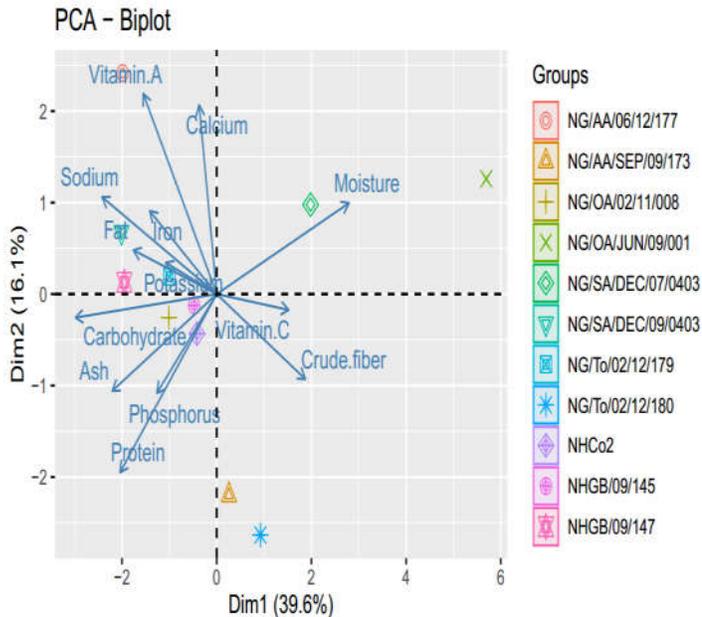


Figure 4: Principal component analysis of the relationship that exists between the proximate parameters, physicochemical parameters of *Corchorus olerius*, and the accessions.

Discussion and Conclusion

The qualitative and quantitative tests (Tables 1 and 2) revealed a wide range of substances (vitamin A and C, fat, crude fibre, protein, carbohydrate, ash, moisture, potassium, iron, sodium, phosphorus, and calcium). Knowing the constituents can help one to speculate on the medicinal value of *C. olerius L.* leaves such as antioxidant (Hillocks, 1998) and antibacterial (Pal *et al.*, 2006). PCA result (fig.1) showed that protein, crude fibre, and ash contributed positively and significantly (52.1%) to the plant contents while carbohydrate, vitamin A and C, moisture and fat constitute less (18.39%) indicating jute as a healthy leaf vegetable. Positive and strong significant proportion were observed in NG/AA/SEP/09/173 (Protein), NG/To/02/12/180 (crude fibre), NG/OA/02/11/008 (ash), NG/SA/DEC/07/0403 (carbohydrate), NHC0-2 (vitamin C), NG/AA/06/12/177 (vitamin A) and fat was traceable in all the accessions. This will aid the plant breeders in the selection and improvement or production of new hybrids.

Furthermore, the phytonutrients and chemicals indicated linkage amongst them (fig.2). Crude fiber, carbohydrate, ash, protein, vitamin C, and phosphorus gave 39.6% of the relationship. More so, protein, crude fiber and carbohydrate were positive and strongly significant whereas; vitamin A moisture, calcium, sodium, iron, fat and potassium recorded 16.1%. vitamin A, calcium, moisture and sodium were significantly linked indicating that there exists interdependency among the constituents. The presence of phytochemicals suggests that it is pharmacologically active, supporting the traditional use for treating malaria mostly in pregnant women and children who are malnourished (UNICEF 2021) data on world malnutrition of pregnant women and children (under 5 years of age). This is in agreement with the work of (Ali, 2012) who examined fruits and

plants from India and Iran to ascertain the proportion of anti-nutrients present in them and (Adesuyi *et al.*, 2012) who examined the *Garcinia kola* nutrients for its ethnobotanical roles. Also, corroborate with Eze and Obinwa (2014) work who confirmed the trade-medicinal importance of the leaves and fruits of *Nauclea latifolia*.

More so, there is significant and high association of moisture with vitamin C and crude fibre, calcium with vitamin A, protein with ash, carbohydrate and phosphorus, while sodium, potassium, iron and fat are weakly significant with protein. This means that the deeper the blue indicator the closer, stronger and positive the connection between the plant contents and the deeper the red indicator the more distinct the contents (fig. 3). The results showed that the connection between the nutrients, chemicals and accessions are significant and the similar (fig.2 and 4) and would be critical in plant breeding and improvement (fig. 4). This discovered that the accessions contain all the essential elements and classes of food needed for man and animal growth and development. However, variability in concentration may be environmental or other factors that could be responsible.

Conclusively, since the entire essential daily nutrients are present in the accessions studied; it is recommended for the members of the community to include it in their daily diet to enhance their immune system (Adesuyi *et al.*, 2012) and (UNICEF 2021) as it constitutes major materials required for proper physiological functioning of the body as in Potassium which aids in lowering blood pressure, Fibers eliminating constipation, Vitamin C preventing infections and enhancing bone health, etc. thus improving healthy living.

Finally, jute recommendation is for both young and aged ones as it makes a complete diet to low income earners and poor people due to its richness in potassium, calcium, phosphorus, protein, crude ash, carbohydrate, moisture, and vitamin C; low

contents in sodium, iron and a trace of fat hence improving nation's food security. This could also serve as a source of income to the farmers due to its ease of cultivation, early maturity, grown in all seasons and soil type, and can also be intercropped with another farm produce. This has been proven by NIHORT experts in 2012. It could be used in novel drug and agro-allied industries for jute processing, carpet production thereby improving the economy status of the nation.

Conflict of Interest

The authors hereby state that there is no existing conflict of interest.

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