Journal of Agriculture and Food Environment

Volume 11(1): 22-28, 2024

Faculty of Agriculture
Delta State University
Abraka, Nigeria

Baiyeri et al., 2024

Website: www.jafedelsu.org: Email: info@jafedelsu.com

Original Research Article

Assessment of the Nutritional Composition of the Fruits of Jute Mallow (*Corchorus olitorius*)

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Received 8th December 2023; Accepted 22nd January, 2024; Corrected 26th February, 2024

Abstract

Corchorus olitorius is a multipurpose leafy green vegetable with enormous nutritional and nutraceutical advantages. Nutritional quality of the edible portions of crops is largely influenced by genotypes and crop management practices. The study investigated the variation in the nutrient quality of fresh fruits of organically produced *Corchorus olitorius* accessions. Poultry manure was applied at the rate of 10 tonnes per hectare. Proximate and selected mineral contents of the fresh fruits were assayed. The proximate and mineral contents of the fresh *Corchorus* fruits were significantly ($p<0.05$) influenced by accession (cultivar). The crude protein was in the range of 2.4-2.9%, crude fibre 1.6-1.94%, ash 1.46-2.30%, crude fat 0.13-0.18%, carbohydrate 5.14-7.16%, moisture 85.20-89.22%. Co-Ekiti had the highest concentrations of the crude protein, crude fat, ash, carbohydrate, crude fibre and the least moisture content. Manganese (Mn) was in the range of 1.5-5.64mg/100g; Phosphorus (P), 43.25-85.50mg/100g; copper (Cu), 0.13-0.23mg/100g; sodium (Na), 10.92-11.88mg/100g. Co-Ekiti recorded the highest Mn content, Co-Lagos had the highest Na content, while Cu and P concentrations were highest in Co-Osun. Co-Ekiti had the highest concentrations of crude protein, crude fat, ash, crude fibre and recorded the least moisture content. Co-Ekiti demonstrated superior nutrient quality and its production and consumption are recommended.

Keywords: *Corchorus olitorius*, minerals, proximate, fruits, vegetable

Introduction

Global hunger, which is the measure of the prevalence of undernourishment, has remained unchanged, affecting about 9.2 percent of world's population in 2022. Around 900 million (11 percent) people in the world were severely food insecure, while 2.4 billion were reported to be moderately or severely food insecure in 2022 (FAO, 2023). The report further noted that while progress was made towards reducing hunger in Asia and Latin America, hunger is still on the increase in Western Asia, the Carribean and in the sub-regions of Africa. Baiyeri *et al.* (2023a)

noted that malnutrition was considered the problem of the resource-poor people in time past; however, research efforts in recent times have revealed that "hidden hunger" (micronutrient malnutrition) is a more complex nutritional challenge and could be less obvious. Hidden hunger affects the elites as well as the resource-poor people. There are however promising opportunities in the underutilized and neglected crops, especially the indigenous fruits and vegetables that have not been exploited, for global food and nutrition security.

Cochorus olitorius is one of these important and multipurpose green leafy vegetables with enormous opportunities for food, medicine and raw materials that are yet to be exploited. *Cochorus olitorius* is considered to be a native to the African and Asian continents, but grown in South America, Africa, Australia and some parts of Europe for dietary preparations and industrial use (Tulio *et al.*, 2002; Kundu *et al.*, 2012). It is valued for its high mineral, vitamin and phenolic contents (Giro and Ferrante 2016). It is an excellent source of bioactive compounds, protein, certain hormones, and carbohydrates (Steyn *et al.*, 2001; Dansi *et al.*, 2008). Earlier reports have shown that this green leafy vegetable has enormous nutraceutical and medicinal values (Ahmed, 2021; Biswas *et al.*, 2022)). The nutritional and the antinutritional values of its fruits have been reported by various authors (Samuel *et al.*, 2020, Baiyeri and Samuel-Baiyeri, 2022; Baiyeri, *et al.*, 2023b).

Antinutritional and nutritional compositions of crops are usually affected by a number of genetic and environmental factors. Soil nutrition (soil fertility) is one of the environmental factors that largely influence nutritional quality of the edible portions of crops. Numerous advantages have been associated with organic fertilizers like poultry manure that make them invaluable for high yield in crop production and enhanced nutritional quality. Organic fertilizers increase the organic matter content of the soil, thereby enhancing its fertility. They improve soil cation exchange capacity and promote soil aggregates. They enhance soil structure, improve air spaces and water retention capacity, thereby improving root growth and development as well as nutrient uptake (Roba, 2018). Organic fertilizers play major roles in sustainable intensification of crop production since they are released slowly in the soil in a sustained manner. Baiyeri and Samuel-Baiyeri (2022) reported the nutritional and anti-nutritional contents of fresh fruits of *Cochorus* grown using inorganic fertilizer (N.P.K.). Baiyeri *et al.* (2023b) reported the nutritional and anti-nutritional composition of the fruits of *Corchorus olitorius* organically grown using poultry manure at five tonnes (5 tonnes) per hectare. Increasing organic fertilizer usage has been reported to influence nutritional quality in a green leafy vegetable production (Baiyeri *et al.*, 2015). It was deemed necessary to investigate the differences in the nutritional composition of the fruits of *Corchorus olitorius* accessions as a response to higher poultry manure application, than the rate that had been earlier reported. This study was therefore initiated to investigate the effect of organic fertilizer (poultry manure at 10 tonnes/ha) on the nutritional quality of the fresh fruits of five Nigerian accessions of *Corchorus olitorius*.

Materials and Methods

***Sample collection*:** Fresh fruits of *Corchorus olitorius* were collected from an agronomic evaluation of *Corchorus* accessions (cultivars) collected from Ekiti, Lagos, Ondo, Osun and Oyo States, Nigeria. Each accession was named after the state where it was collected from; having the prefix Co-State attached to it. The *Corchorus* accessions were evaluated on the field using well-curred poultry manure (13% moisture content) applied at 10 tonnes per hectare. No

agrochemicals were used in growing the vegetable. The collected fresh fruit samples were put into new and well labeled envelopes and immediately taken to the laboratory for biochemical analysis.

Proximate analysis: Proximate analysis was carried out using AOAC (2005) methods. Crude protein was analysed using the AOAC 2005 (955. 04), crude fat (954.02), moisture (930.15), ash (920.117) and crude fibre (978.10). Carbohydrate was obtained by taking the difference: 100% - (% moisture + crude protein + crude ash + crude fibre).

Mineral analysis: The minerals were analyzed using AOAC 2005 method (968.08). Mineral concentrations in the digested fresh fruit samples of *Corchorus* were determined using Buck Scientific Atomic Absorption Spectrophotometer (Model: 210VGP).

***Statistical analysis*:** All nutritional data collected were analyzed using the R statistical analysis package version 4.1.1. The analysis of variance was done using the library *Agricolae.*

Results and Discussion

The accessions significantly (P<0.05) influenced the proximate composition of the *Corchorus* fruits as shown in Table 1. Co-Ekiti had the highest concentrations of crude protein, crude fat, ash and crude fibre. Co-Ekiti recorded the least moisture content. Co-Ondo accession recorded the lowest (P<0.05) crude protein, ash and carbohydrate contents. Co-Lagos recorded the least fibre content, while Osun had the least crude fibre content. The crude protein was in the range of 2.45-2.90%, crude fibre 1.61-1.94%, ash 1.46-2.30%, crude fat 0.13-0.18%, carbohydrates 5.14-7.16%, moisture 85.20-89.22%.

Table 1. Proximate composition (%) of the fresh fruits of *Corchorus olitorius* accessions

Accession	Crude protein	Crude fat	Crude ash	Moisture	Dry matter	Carbohydrate	Crude fibre
Co-Ekiti	2.90^{a}	0.18^{a}	2.24^{a}	85.20^{b}	14.80	7.16^{b}	1.94
Co-Lagos	2.45^{c}	0.17^{a}	1.46^{b}	88.51^{ab}	11.49	5.94^{c}	1.49
Co-Ondo	2.24^{d}	0.16^{a}	1.46^{b}	89.22^{a}	10.78	5.14^{d}	1.80
Co-Osun	2.75^{b}	0.13^{b}	2.30^{a}	87.23^{ab}	12.77	8.16^{a}	1.61
Co-Oyo	2.32^{d}	0.14^{b}	1.84^{ab}	86.89^{ab}	13.11	6.90^{b}	1.92
Mean	2.53	0.16	1.86	87.41	12.59	6.66	1.75

Within each column, means followed by different letters are significantly different by a Tukey's HSD test at $\alpha = 0.05$

The mineral contents of the fresh *Corchorus* fruits were significantly (p<0.05) influenced by accession (Table 2).

Table 2. Mineral composition (mg/100 g) of fresh fruits of *Corchorus olitorius* accessions

Accession	Phosphorus	Manganese	Sodium	Copper
Co-Ekiti	64.60^{d}	5.64^{a}	10.92^{d}	0.13^{c}
Co-Lagos	43.25^{e}	2.64^{d}	11.88^{a}	0.23^{b}
Co-Ondo	66.35^{c}	1.52^{e}	11.16^{c}	0.14^{c}
Co-Osun	85.50^{a}	4.65^{b}	11.66^{b}	0.27^{a}
Co-Oyo	70.53^{b}	3.18^{c}	11.24^{c}	0.15^{c}
Mean	66.05	3.53	11.37	0.18

Within each column, means followed by different letters are significantly different by a Tukey's HSD test at $\alpha = 0.05$

Manganese (Mn) was in the range of 1.5-5.64mg/100g, Phosphorus (P) 43.25-85.50 mg/100g, copper (Cu) 0.13-0.23mg/100g, and sodium (Na) 10.92-11.88mg/100g. Co-Ekiti recorded the highest Mn and the least Na and Cu concentration, Cu and P was highest in Co-Osun, while Co-Lagos recorded the least P content.

Discussion

The proximate composition of the fresh *Corchorus* fruits analysed in this study was comparable with what has been reported for fresh okra pods (fruits) per 100 g (protein 2.1g, carbohydrate 8.2g, fat 0.2g, fibre 1.7g, moisture 88.6g). The proximate quality result was within the range of what had been reported by Baiyeri and Samuel-Baiyeri (2022) and Baiyeri *et al.*, (2023b) for fresh *Corchorus* fruits. The crude protein in the fruits of these accessions in the present study was however higher than the crude protein that Samuel *et al.* (2020) had reported in *Corchorus olitorius* fresh fruits. Fruits of the *Corchorus* accessions that were grown with 10 tonnes/ha of poultry manure in this study did not significantly differ in their proximate quality when compared with the proximate composition of *Corchorus* fruits grown with 5 tonnes of poultry manure (Baiyeri *et al.*, 2023b). This suggests that the application of more than 5 tonnes per hectare of poultry manure for enhancing proximate quality in the production of fruits may not necessarily result in significantly higher nutrient contents than the levels obtained in this study which is similar to the proximate composition of *Corchorus* fruits that received 5 tonnes per hectare of poultry manure (Baiyeri *et al.*, 2023a). Hence the application of poultry manure at rates above 5 tonnes/ha, solely for enhanced proximate composition, may not be recommended and could result in huge economic losses considering the costs of its purchase, transportation, and its application.

The Na and P contents of the fresh *Corchorus* fruits were slightly higher than the levels reported for dry okra pods by Habtamu *et al.* (2015 and 2016). The Mn and P in the present study were higher than what have been reported for fresh *Corchorus* fruits by Samuel *et al.* (2020), but Na was higher in the fruit of the accession they analyzed. The four minerals in this study were similar in their concentrations of Mn, P, Cu and Na contents of fresh *Corchorus* fruits grown with the application of 5 tonnes/ha of poultry manure (Baiyeri *et al.*, 2023b). This suggests that 5 tonnes/ ha of poultry manure could be optimum for the levels of the minerals obtained in this study.

Manganese and copper are very important micronutrients in human nutrition. Manganese functions as an activator in many enzymatic reactions; its major physiological role is that it functions as an enzyme cofactor involved in antioxidant reactions that have to do with glucose metabolism (carbohydrate metabolism and gluconeogenesis) (Guerrero-Romero and Rodríguez-Morán, 2005); Huskisson *et al.*, 2007; Shenkin 2008). Primarily, copper functions are related to enzyme activities that include Phase-I detoxifying enzymes (i.e., the cytochrome C oxidase family of enzymes). Furthermore, Cu is also very important for the development of nerve coverings (myelin sheath) and connective tissues. Copper is also involved in the metabolism of iron (Guerrero-Romero and Rodríguez-Morán, 2005; Huskisson *et al.*, 2007; Shenkin 2008: Umar *et al.*, 2011)). Phosphorus is closely associated with calcium homeostasis, and is also connected with bone and teeth formation and most of the metabolic actions in the body, including the contraction of the heart muscles, kidney functioning and cell growth (Theobald,

2005; Szefer and Grembecka, 2007; Renkema *et al.*, 2008). Phosphorus in the form of Phosphate plays a crucial role in the production of ATP, GTP and CP as energetic substances, and regulates the activity of a number of proteins by means of phosphorylation reactions (Sobotka *et al.*, 2008). In human physiology, sodium plays a major role in the maintenance of the balance of physiological fluids (kidney function, nerve and muscle functions and blood pressure) (French and Zamponi, 2005; Sobotka *et al.*, 2008; Awuchi *et al.*, 2020).

This study has further revealed that *Corchorus olitorius* fruit is nutrient-rich, and its consumption could be helpful in enhancing human nutrition and health and in combating malnutrition. The opportunity in it as an ingredient for soups and dietary preparations should therefore be explored to the advantage of those that cherish green vegetables and especially the consumers of *Corchorus* leaves, who are not aware of the nutrient-density of the fruits. Efforts should therefore be made to create awareness about the nutritional potentials of *Corchorus* fruits; this will enhance its production and it could become an additional source of income to the farmers that grow *Corchorus* for its leaf and fibre.

Conclusion

The study revealed the nutritional composition (proximate and mineral) of the fresh fruits of the *Corchorus* accessions produced with application of 10 tonne/ha of poultry manure. Producing *Corchorus* fruits with the application of 5 tonnes/ ha of poultry manure could be optimum for the levels of the minerals and proximate quality obtained in this study. Co-Ekiti demonstrated superior nutrient quality and its production and consumption are recommended.

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