NUTRIENT, ANTINUTRIENT AND SENSORY EVALUATION OF *CORCHORUS OLITORIUS* FRUIT

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ABSTRACT

Corchorus olitorius is a widely consumed indigenous green leafy vegetable in Nigeria, however the consumption of its fruit is less known. This study was designed to determine the nutrient and anti-nutrient composition of raw and cooked C. olitorius fruit. The sensory acceptability of C. olitorius fruit soup was also compared with the commonly consumed C. olitorius leaf soup. Proximate composition, mineral and anti-nutrient analyses of C. olitorius fruit were carried out using standard procedures. Sensory evaluation of soup cooked from C. olitorius fruit and C. olitorius leaves was carried out. Results obtained showed that the raw C. olitorius fruit composed of moisture (84.95%), crude protein (1.58g/ 100g), crude fat (0.20g/ 100g), crude fibre (2.03g/ 100g), ash (2.45g/ 100g), carbohydrate (10.82g/ 100g) and energy (51.4 kcal/100g). Cooked C. olitorius fruit soup had moisture (92.58g/ 100g), crude protein (1.10g/ 100g), crude fat (0.10g/ 100g), crude fibre (1.44g/ 100g), ash (1.08 g/ 100g), carbohydrate (5.14g/ 100g) and energy (34.9 kcal/100g). Both the raw and cooked seed sample contained appreciable amounts of minerals especially calcium and potassium. Among the anti-nutrients determined, tannin value (133mg/ 100g) was highest in the raw C.olitorius fruit sample. Sensory evaluation showed significantly higher overall preference for C. olitorius fruit soup over C. olitorius leaf soup. The consumption of soup made from C. olitorius fruit has nutritional benefits and was also found to be acceptable to consumers. It is recommended that the consumption of C. olitorius fruit soup should be preserved where it is already being consumed and promoted in other parts of Nigeria where it is not well known.

Keywords: Indigenous vegetable, nutrient composition, acceptability

INTRODUCTION

Corchorus olitorius, also locally known as ewéédú (in Yorùbá language) and bush okra and jute mallow (in English language), is a popular indigenous vegetable crop that is widely cultivated and consumed in Nigeria (Akoroda, 1985). It is one of the seven highly valued indigenous leafy vegetables in Nigeria (Adebayo *et al*., 2003) and features prominently as a common dish in published research done among consumers in Southwestern Nigeria (Morakinyo *et al*., 2016; Sanusi and Olurin 2012; Onabanjo and Oguntona 2003; Oguntona *et al*., 1999).

Although the plant is popular for it leaves, it also produces fruits which are capsule-like, cylindrical, straight or slightly curved in shape and can be up to 3 - 7 cm long and 2 – 4 cm in girth with many seeds (Osawaru *et al.*, 2012, Banerjee *et al*., 2012). The fruits are usually green when fresh and dark brown when fully matured (Osawaru *et al.*, 2012). Different parts of this important vegetable crop are reported to be used for several medicinal purposes such as tonic, diuretic, remedy for aches, stomach pains, stimulation of appetite, laxatives, including anti-bacterial activities and in the management of diabetes mellitus (Ejoh and Samuel, 2016; Loumerem and Alercia,

2016; Oboh *et al*., 2009; Abo et al, 2008; *Pal et al*., 2006; Velempini *et al*., 2003). In addition, *C. olitorius* leaves have been reported to be rich in vitamins, minerals and phenolic and antioxidant properties (Choudhary *et al*., 2013**;** Nemba *et al*., 2012, Oboh *et. al*., 2012; Ndlovu and Afolayan, 2008; Oboh *et. al*, 2009; Zeghichi *et al*., 2003).

Among the Yorùbá of southwest Nigeria, *C. olitorius* leaf soup (ewéédú soup) serves as an accompaniment to starchy staples like 'amala' or 'eba' (pudding made from yam or cassava flour) or pounded yam. The slimy nature of the soup makes it suitable for easy consumption of such starchy balls (Garjila *et al* 2017). However, among the Okun people – the Yorùbá-speaking communities in Kogi State of North-central Nigeria, the young fresh fruits (pods) of *C. olitorius* are also utilised as food and are cooked as a delicacy known as Tànkèlèkàn, which is served in a similar manner as its counterpart ewédú soup made from C. *olitorius* leaves. Generally, the consumption of soup from the fruit of *C. olitorius* is not as widespread as soup made from C. *olitorius* leaves, thus, *w*hile several of studies have been reported on the nutritive value of the leaves of *C. olitorius*, information on its relatively less consumed fruit is scarce in literature.

This study was therefore carried out to determine the nutrient and anti-nutrient composition of raw and cooked *C. olitorius* fruit. In addition, sensory attributes of soup made from *C. olitorius* fruit and soup made from *C. olitorius* leaves was compared.

MATERIALS AND METHOD.

Collection and preparation of fruit of *C. olitorius* for nutrient analysis

Corchorus olitorius fruit was obtained from a farm at The Polytechnic, Sango area of Ibadan, Ibadan, Oyo State. The fresh samples were plucked, rinsed properly and then blended in the raw form into a slurry. The slurry was divided into two parts; the first part labelled sample A was analysed raw while the second part (sample B) was cooked in one cup of boiling water for about 5 minutes and set aside to cool before analysis. The raw and cooked samples of *C. olitorius* fruit were analysed in the Department of Human Nutrition Laboratory, University of Ibadan and Kappa Biotechnology Laboratory, Ibadan.

Proximate and Mineral Analysis of raw and cooked fruit of *C. olitorius*

Analyses were as determined according Association of Official Analytical Chemists (AOAC, 2010). For moisture, ash, protein, crude fibre, fat content analyses were carried in triplicate and all values were reported in g/100g edible portion. Magnesium, iron and manganese were determined using BUCK 200 AAS, phosphorous was determined by atomic absorption spectrophotometry method while sodium, calcium and potassium were determined using flame photometry method (AOAC, 2010). The results were given as mean of the results ± standard deviation in mg/ 100g.

Anti-nutrient analysis of raw *C. olitorius* fruit.

The anti-nutrients analysed include oxalate, phytate, tannin, alkaloids and cyanogenic glycosides, these were determined using the methods of AOAC (2010).

Preparation of soups from *C. olitorius* leaves and *C. olitorius* fruit for Sensory Evaluation

Preparation of soups was done using standard recipes. One bunch (950g) of *C.*

olitorius stems with leaves were destalked and washed thoroughly to remove dirt. Two cups of water were added to a medium size pan and brought to boil. Destalked *C. olitorius* leaves were added to the boiling water in the pot and allowed to boil for 2 minutes. 1 tablespoon of locust beans was added and boiling of the mixture continued until the leaves were tender (about 5 minutes). A traditional utensil, called *ìjábè* made specially for pulverizing cooked tender leaves of *C. olitorius* was used to pulverise the leaves to a semi puree consistency. After this, salt was added to taste. The whole mixture was allowed to simmer for another 3 minutes. The total cooking time was about 8 minutes.

Fresh *C. olitorius* fruit soup was prepared by washing about thirty (30) *C. olitorius fruits* thoroughly to remove dirt. The fruit were then chopped into small pieces and added to 2 cups of boiling water, allowed to boil for 2 minutes before adding one tablespoon of locust beans (local spice) and allowed to boil for about 5 minutes. Salt was added to taste and allowed to simmer for 3 minutes. The total cooking time was about 10 minutes.

Sensory evaluation procedure

The sensory evaluation of the two soup samples was carried out for consumer acceptance and preference. Thirty (30) untrained panellists were randomly selected from among students of the Department of Human Nutrition, University of Ibadan, Nigeria. University of Ibadan is located in the South-Western part of the country, where Tànkèlèkàn, is not widely consumed. A 9-point hedonic scale was used to assess sensory qualities of the two soup samples: the scale where "1" represented "extremely dislike" and "9" represented "extremely like" was used. The qualities assessed include: colour, taste, aroma, texture (sliminess) and overall acceptance. Coded samples of the same quantity (50 ml) and temperature (29ºC) were served to each of the panellists.

STATISTICAL ANALYSIS

The mean and standard deviation of the triplicate determination of the proximate and mineral analysis of raw and cooked *C.olitorius* fruit samples were carried out, respectively. Sensory evaluation scores were summarised using mean and standard deviation. Paired sample *t-test* was used to test for significant differences in the sensory evaluation scores of *C.olitorius* fruit and leaf soup samples, respectively.

RESULTS AND DISCUSSION

Nutrient and anti-nutrient composition of *C. olitorius* fruit

Table 1 shows the proximate composition obtained for raw and cooked *C. olitorius* fruit samples.

TABLE 1: PROXIMATE COMPOSITION OF RAW AND COOKED *C. OLITORIUS* FRUIT SAMPLES (G/100 G).

Composition	Raw *C. olitorius* fruit	Cooked *C. olitorius* fruit	p-value
Moisture content	84.95 ± 0.55	92.80 ± 0.08	0.001
Crude protein	1.58 ± 0.06	1.10 ± 0.01	0.004
Crude fat	0.20 ± 0.01	0.10 ± 1.7E-17	0.001
Ash	2.45 ± 0.09	1.08 ± 0.01	0.002
Fibre	2.03 ± 0.07	1.44 ± 0.02	0.001
Carbohydrate	10.82 ± 0.40	5.14 ± 0.07	0.001
Energy (kcal/g)	51.4	34.9	0.000

Values are mean ± standard deviation of triplicate determination.

In general, results showed that the *C. olitorius* fruits had very low protein, carbohydrate and fat content both in their raw and cooked forms. The nutrient values of raw *C. olitorius* fruit obtained in the present study were lower than reported by Ndlovu and Afolayan (2008). Several factors could be attributed to this difference including: post-harvest condition, method of processing before analysis, varieties of *C. olitorius* used, analytical methods used, stage of maturation (Lee and Kader, 2000). Ndlovu and Afolayan (2008) observed that the ash, crude lipid and crude protein content of *C. olitorius* leaves were higher than that of the fruit in their study. It is difficult to make further comparisons with similar studies due to the paucity of studies on *C. olitorius* fruit.

In the present study, raw *C. olitorius* fruit was found to contain appreciable amount of minerals especially calcium and potassium, but low in iron and sodium. Potassium and sodium balance play an important role in cardiovascular health and fluid balance in the human body (Adrogué and Madias, 2007). Furthermore, the low sodium content of raw *C. olitorius* fruit observed in our study makes it a potential food source in the management of health conditions that require sodium-restricted diets.

As shown in Table 2, cooking appeared to significantly reduce the calcium, potassium and sodium content but significantly increased magnesium content of *C. olitorius* fruit. The decrease in the nutrient content of cooked *C. olitorius* fruit can be attributed to effect of cooking on nutrients, which has been widely reported in literature (Fabri and Crosby, 2016, Hefnawy, 2011). Lewu *et al.* (2009) reported that cooking significantly reduced the ash, carbohydrate and caloric content of some accessions of *Colocasia esculenta* (L.) found in South Africa, and Mepba *et al.* (2007) reported lower crude protein, lipid and mineral content in cooked *C. olitorius* leaves compared to the raw leaves. Studies have also shown that cooking methods can either improve or reduce the nutritional quality of foods (Fabri and Crosby, 2016). In a recent study (Issa *et al.*, 2020) common cooking practices including boiling was found to alter nutrient content of traditional vegetables (including *C. olitorius*) in Malawi. It is therefore important to explore cooking methods that contribute to nutrient retention in *C. olitorius* fruit.

TABLE 2: MINERAL COMPOSITIONS OF RAW AND COOKED *CORCHORUS OLITORIUS* FRUIT SAMPLES (MG/100 G).

Composition	Raw *C. olitorius* fruit	Cooked *C. olitorius* fruit	p-value
Calcium	141.74 ± 1.07	38.35 ± 0.44	0.003
Magnesium	1.16 ± 0.06	5.95 ± 0.11	0.005
Potassium	320.59 ± 2.14	70.60 ± 0.14	0.004
Manganese	0.21 ± 0.06	0.10 ± 0.03	0.318
Iron	0.34 ± 0.08	0.22 ± 0.05	0.126
Phosphorus	4.92 ± 0.42	2.29 ± 0.06	0.082
Sodium	40.21 ± 0.00	14.89 ± 0.59	0.010

Values are mean ± standard deviation of duplicate determination

Table 3 shows that raw *C. olitorius* fruit contains appreciable levels of anti-nutritional factors, in particular tannins (133mg/100g), while cyanogenic glycocides were not detected. Antinutrients are reported to reduce the bioavailability of nutrients to the body particularly when they are present in high amounts (Sango *et al*., 2016). For example, phytate and oxalates form chelates with minerals like calcium and magnesium which are di-valent minerals, thereby causing them to be poorly absorbed from the gastrointestinal tract (Aletor and Adeogun, 1995). Food preparation methods, particularly cooking can reduce the presence of anti-nutrients to less harmful levels (Fabri and Crosby, 2016, Hefnawy, 2011, Yadav and Sengal, 2003). However, a drawback of this present study is that anti-nutrient composition of cooked fruit sample was not analysed.

TABLE 3: ANTI-NUTRIENT COMPOSITION OF RAW *C. OLITORIUS* FRUIT (MG/ 100G).

Anti-nutrient	Value
Oxalates	68.33 ± 5.77
Tannins	133.33 ± 10.41
Alkaloids	23.33 ± 2.89
Phytates	46.67 ± 2.89
Cyanogenic glycosides	Nil

Values are mean ± standard deviation of triplicate determination.

Sensory evaluation of soups from *C. olitorius* fruit and leaves

Sensory evaluation results showed that the taste and texture (sliminess) of soup made from *C. olitorius* fruit were rated higher ($p<0.05$) than that of the leaves (Table 4). It is important to note that the fruit soup was slimier than the leaf soup, and this may be the reason for the higher rating for texture for the fruit soup. Sliminess (mucilaginous texture) is an important desirable attribute of the *C.olitorius* leaf soup (ewéédú) in Nigeria.

Conversely, the colour of soup made from *C. olitorius* leaves was more acceptable than that of the fruit. There was no

significant difference in the panellists' assessment of the aroma of both soups. Overall, *C. olitorius* fruit soup was more preferred as shown by the overall acceptability mean scores, which were significantly higher ($p<0.05$) than for *C. olitorius* leaf soup.

TABLE 4: SENSORY ATTRIBUTES OF *COCHORUS OLITORIUS* LEAF AND FRUIT SOUP SAMPLES

Sensory attributes	*C.olitorius* leaf soup	*C.olitorius* fruit soup	*p-value*
Colour	7.57 ± 0.82	6.47 ± 1.01	0.000
Aroma	7.03 ± 0.89	7.43 ± 1.17	0.120
Taste	6.90 ± 1.06	7.50 ± 1.25	0.037
Texture (sliminess)	6.77 ± 0.90	7.93 ± 0.98	0.000
Overall acceptability	7.10 ± 0.99	7.90 ± 1.06	0.006

Values are mean ± standard deviation.

CONCLUSION

The findings of this study showed that *Corchorus olitorius* fruit, when cooked as soup, has the potential to contribute modestly to nutrient intake. The soup was found to be well accepted. Hence, it is recommended that its consumption should be promoted in addition to the already popularly consumed *Corchorus olitorius* leaf soup (ewéédú soup) not only where it is already widely consumed, but also in other parts of Nigeria where it is not well known and consumed.

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