Nutritional, Zn bioavailability and antioxidant properties of water leaf (*Talinum triangulare)* mucilage

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Introduction

Vegetables and fruits contain high concentration of numerous redox-active antioxidants such as polyphenols, carotenoids, ascorbic acids, tocopherol and flavonoids which fight against hazardous oxidative damage of plant cells. In animals, antioxidants production is much more limited and generation of free radicals during metabolism beyond the antioxidant capacity has been implicated in the pathogenesis of most diseases (Olajire and Azeez 2011). Thus, the consumption of dietary antioxidants from vegetables and fruits is beneficial in preventing these diseases and it has been proven to substantially reduce the risk of cardiovascular diseases, cancers and neurodegenerative diseases, including Parkinson's and Alzheimer's diseases (Olajire and Azeez 2011; Morrison and Twumasi, 2010). Water leaf *Talinum triangulare* is consumed as a vegetable and constituent of a sauce in Nigeria. In Nigeria, it is widely distributed and consumed as a leafy vegetable in the Southern ecological zones. Its leaves are used as softener of other vegetable species in vegetable soup (Aja, et al; 2010). In South West and South East Nigeria, when water leaf is to be cooked the leaves are squeezed with or without salt to remove the mucilage from the leaf before cooking, the resultant extracted mucilage are thrown away. Thus, this study sought to evaluate the nutritional, Zn bioavailability and antioxidant properties of *Talinum triangulare* (water leaf) mucilage.

Materials and methods

Water leaf *Talinum triangulare* vegetables were purchased from a local market in 'Oja Ikoko', in Owo, Ondo-State.

The mucilage was extracted according to the method of Woolfe et al (1977) with slight modification. The leaves were removed from the stalk, cleaned, shredded and homogenized with five times its weight of water, it was then filtered and the greenish, viscous solution obtained. The solution was heated at 70^0Cfor 5minutes to inactivate enzymes and re-filtered. The mucilage was precipitated with three times volumes of ethanol and washed with more ethanol followed be acetone. The greenish coloured solid was dried in an oven at the temperature of 45^{0}C for 12 hours; it was scraped and gave a yield of 21g mucilage/Kg water leaf.

Nutrient composition (fat, crude fibre, and ash) was determined by the standard method of the Association of Official Analytical Chemist AOAC (1990). The protein content was determined using the micro-Kjedahl method ($N \times 6.25$) and carbohydrate determination was by difference. Food energy was calculated by the method of Jideani and Bello (2009) using the factor of $[(4 \times \text{Protein}) + (4 \times \text{Carbohydrate}) + (9 \times \text{Fat})]$.

The phytate content was determined by the method of Maga (1982). The mineral contents were determined using an atomic absorption spectrophotometer Bulk scientific AAS (model 210/211 VGB). The method of Ferguson *et al.* (1988) was used for the calculation of phytate - zinc, calcium - phytate and [Ca] [phytate]/ [Zn] molar ratios and used for the Zn bioavailability prediction [Phytate = 660, Zn = 65.40, Ca = 40]

The aqueous extracts of the water leaf mucilage were prepared using a modified procedure described by Oboh et al. (2010). About 10 g each of the powdered mucilage was homogenised in 100 mL distilled water in a Warring blender for 5 min. Thereafter, the mixture was centrifuged at 2000 g for 10 min. The supernatant was used for the determination of total phenolic content, vitamin C and antioxidant activity (reducing power and DPPH free radical scavenging ability). The vitamin C content of the aqueous extract, the total phenol content, the extractable flavonoid content, the reducing property and the Free radical scavenging activity of the extracts were determined according to the methods described by Oboh et al. (2010).

Statistical analysis

The results of the three replicate readings were pooled and expressed as mean ± standard deviation. Standard deviations were calculated using spread sheet soft ware (Excel©)

Result and discussion

The proximate composition of the mucilage of water leaf is presented in Table 1. The protein was found to be 54.30g/100g. This value was higher than the protein content of the leave of water leaf 3.52% and 5.10% (Aja et al; 2010, Kwenin et al; 2011). Cells are ruptured during homogenisation and cellular proteins are released into the mucilage, this could account for the high value of protein in the mucilage. The high value of protein in the mucilage could also be attributed to leaching of protein from the leaf into the mucilage. The fibre content of the mucilage 3.50g/100g was very low when compared with the fibre content of the leave of water leaf 12% and 8.5% (Aja et al 2010). The low fibre in the mucilage could be attributed to the fact that the fiber constitutes the residue of the leaf after homogenisation and sieving to remove the mucilage.

Table 1: Proximate composition of water leaf mucilage (g/100g)

Moisture	Fibre	CHO	Fat	Protein	Ash	Energy
8.60±0.20	3.50±0.16	5.40±0.10	29.00±0.12	54.30±0.70	7.80±0.20	499.8

Values represent mean ± standard deviation, Energy in Kcal

The mineral content of the mucilage of water leaf as presented in table 2 (Ca, 78.40ppm, Mg, 27.48ppm, Fe, 11.90ppm and Zn, 0.76ppm) were higher than the value reported by Omale and Ugwu (2011) for the leaves of water leaf with the exception of Zn (4.52ppm). The high content of minerals could be attributed to leaching of nutrients into the mucilage during extraction but that of the Zn could have been that it is trapped in the fiber of the leaves which constituted the residue.

Table 2: Phytate and Mineral composition of water leaf mucilage

Phytate g/100g	Ca ppm	Mg ppm	Fe ppm	Zn ppm
2.37±0.15	78.40±0.02	27.48±0.01	11.90±0.02	0.76±0.02

Values represent mean ± standard deviation.

The calculated phytate : zinc, calcium : phytate and [Ca][Phytate]/[Zn] molar ratios of the mucilage of water leaf are presented in Table 3. The calculated phytate : zinc molar ratio (30.0) for the mucilage was twice 15.0, which is considered as the critical value for reduced zinc bioavailability (Ferguson et al., 1988). This is an indication that the phytate present in the mucilage of the water leaf could reduce the Zn bioavailability to a critical level. However the calculated calcium : phytate molar ratio (5.44) was just below 6.0. The calculated [Ca][Phytate]/[Zn] molar ratio (0.59mol/kg) was just above 0.5mol/kg, which is considered as the critical level for reduced Zn bioavailability (Oboh, et al; 2010). This could be because the Zn present in the mucilage is too low, or the Ca content is not high enough to create a sparing effect for Zn from the phytate.

Table 3: Zn bioavailability estimation of water leaf mucilage

Phytate : Zn	Ca : Phytate	[Ca][Phytate] / [Zn]^{x}
30.00	5.44	0.59

^{x}mol/kg

The vitamin C, flavonoid, total phenol and antioxidant activity of the mucilage of water leaf is shown in table 4a and b. The vitamin C content of the mucilage is 10.25mg AAE/g. The high value of vitamin C in the mucilage could be attributed to the solubility of vitamin C in water since water was used in the extraction of the mucilage and the mucilage is largely made up of water. The flavonoids were found to be 9.17 mgQE/g at 250µg/mL and 3.57 mgQE/g at 500 µg/mL while the total phenol was 2.98 mgGAE/g at 50 µg/mL and 1.23 mgGAE/g at 100 µg/mL. It showed from the result that as the dose increases, the value of the flavonoids and the phenol in the mucilage decreases. The reducing powers FRAP and the DPPH scavenging ability of the mucilage of water leaf at 100 µg/mL was found to be 6.37mg AAE/g and 28.78 DPPH% SA respectively. The DPPH scavenging ability of the mucilage was higher than that reported for the leave of water leaf 7.1% (Oboh, et al 2008). This is expected because the phenol content of the mucilage was higher than that of the leaves of water leaf.

Table 4a: Vitamin C, FRAP and DPPH scavenging ability of water leaf mucilage

Vitamin C (mgAAE/g)	FRAP (mgAAE/g)@100 µg/mL	DPPH (%)@100 µg/mL
10.25±0.13	6.37±0.17	28.78±0.20

Values represent mean ± standard deviation.

Table 4b: Flavonoids and Total phenol composition of water leaf mucilage

Flavonoids (mg QE/g)		Total phenol (mgGAE/g)	
250µg/mL	500 µg/mL	50µg/mL	100 µg/mL
9.17±0.11	3.57±0.01	2.98±0.02	1.23±0.15

Values represent mean ± standard deviation.

Conclusion

It is evident from the present work that the antioxidant property of the mucilage of water leaf is high when compared with the leaves as exemplified by the high value of the phenol and vitamin C. The high antioxidant activity as depicted by the high FRAP and DPPH scavenging ability of the mucilage of waterleaf *Talinum triangulare* vegetable can contributes significantly to the health management of man.

Reference

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