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## Assessment of some Antinutrient Properties of the Watermelon (*Citrullus lanatus*) Rind and Seed

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### ABSTRACT

Harnessing food wastes utilization in diets and drugs could improve food supply, health and the environment while antinutrients composition in a food provides an idea of the pharmacologic, dietary and toxic potentials of the food. Thus, this study assessed the antinutrient properties of the rind and seed of watermelon (*Citrullus lanatus*) which are usually discarded as food wastes in Nigeria, using standard protocols. The antinutrients (mg/100 g) in the rind and seed, respectively viz: saponin ( $3.0\pm 0.03$ ,  $2.31\pm 0.01$ ), alkaloid ( $1.39\pm 0.00$ ,  $0.36\pm 1.03$ ), tannins ( $1.33\pm 0.01$ ,  $0.61\pm 0.01$ ), phenol ( $0.53\pm 0.00$ ,  $0.12\pm 0.01$ ) and flavonoid ( $2.87\pm 0.00$ ,  $2.03\pm 0.02$ ) were higher in the rind than in the seed. The content (mg/100 g) in the seed for cyanide ( $0.79\pm 0.01$ ), phytate ( $0.63\pm 1.00$ ) and oxalate ( $0.09\pm 0.00$ ) was higher than that in the rind for cyanide ( $0.00\pm 0.00$ ), phytate ( $0.46\pm 0.00$ ) and oxalate ( $0.08\pm 0.01$ ). The recorded difference in the antinutrients content in the rind and seed samples was not significant ( $p>0.05$ ), hence negligible. The preponderance of these antinutrients in a comparatively lower amount in the samples suggests that the watermelon rind and seed may offer pharmacologic and dietary benefits at a possibly lower toxic risk. Thus, the study supports the use of watermelon rind and seed as food and/or as drug in ethnomedication. Further studies to harness and enhance the utilization of watermelon rind and seed in diets and drugs are required to reduce their attendant waste burden in the environment.

**Key words:** Antinutrients, phytates, oxalates, flavonoids, phenols

### INTRODUCTION

Harnessing food wastes utilization in diets and drugs could improve food supply, health and the environment. Watermelon (family cucurbitaceae and specie *Citrullus lanatus*) is a major fruit widely distributed in the tropics (Yamaguchi, 2006). As reported earlier (Egbuonu, 2015) the fruit pulp serves as a thirst-quencher and an excellent source of minerals, vitamins C and A. Pulp of watermelon (*Citrullus lanatus*) are consumed in Nigeria without, in most cases, consuming the rinds/peels and seeds. This contributes to increasing solid food waste burden in the environment. Such waste burden could be managed by preventing (or at least minimizing) the accumulation of these solid food wastes through efficient waste disposal or by increasing the dietary and industrial utilization of the wastes, warranting basic investigative studies on the properties of agricultural food wastes.

Reported studies on watermelon fruits viz: juice/pulp (Johnson *et al.*, 2012; Oseni and Okoye, 2013), peel/rind and seed (Parmar and Kar, 2009; Lakshmi and Kaul, 2011; Fila *et al.*, 2013;

Gin *et al.*, 2014; Egbuonu, 2015) were silent on the antinutrient compositions of the rind and seed. Generally, although antinutrients, as the name suggests counter the effect of food nutrients, they have pharmacologic properties and (especially at higher quantity) could be toxic by forming insoluble complexes with nutrients and reducing their bioavailability and absorption (Zhu *et al.*, 1997; Akindahunsi and Salawu, 2005; Daniel and Cemaluk, 2011; Adeolu and Enesi, 2013). Thus, antinutrients composition in a food provides an idea of the pharmacologic, dietary and toxic potentials of the food, warranting this study aimed at assessing the antinutrient properties of the rind and seed of the Charleston gray variety of watermelon (*Citrullus lanatus*) which are usually discarded as food wastes in Nigeria.

## **MATERIALS AND METHODS**

**Collection and preparation of samples:** Watermelon fruits were bought from Onuimo market, in Imo State border/boundary with Abia State, Nigeria. It was identified as Charleston gray variety in the Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture Umudike, Nigeria. The watermelon was thoroughly washed to remove sand particles after which it was sliced using a home choice European knife. The seeds were handpicked and washed off the pulp particles using clean water. The pulp was carefully scraped off to obtain the rind which was chopped into pieces with a chipping machine.

The rind chips and seeds were respectively weighed, using Satorious Digital Weighing Balance, Model BP210S, Germany. The rind (wet weight = 1900.7 g) and seed (wet weight = 1016.9 g) were separately spread on a foil and sundried to obtain the corresponding dry weight for the rind (82.6 g) and seed (468.5 g). The respective dry weight samples were milled into powder using Arthur Thomas Laboratory Mill, Crypto model, USA, covered separately in a labeled white nylon and kept in the desiccators prior to use.

**Chemicals and reagents:** All chemicals used, including those used in the preparation of reagents, were of analytical grade and products of reputable companies.

**Determination of antinutrients:** The alkaloid, saponin, phytates and oxalate content in each sample were determined by the colorimetric method (AOAC., 1984). The absorbance of each sample was measured at 420 nm (for alkaloid and phytate) and at 620 nm (for saponin and oxalate) using spectrophotometer and the quantity of the antinutrient estimated from a standard curve obtained by plotting the concentration of the standard antinutrient concentration against the absorbance. The flavonoid content was determined according to method of Bohm and Koupai-Abyazani (1994). 10 g of sample was extracted, repeatedly with 100 mL of 80% aqueous methanol at room temperature. The whole solution was filtered through Whatman filter paper (no. 42, 125 mm). The filtrate was transferred into a crucible, evaporated to dryness over a water bath and weighed to a constant weight.

The cyanide content was determined by the alkaline picrate method (Onwuka, 2005). A portion (5 g) of the sample, ground into paste was dissolved in 50 mL distilled water in a corked conical flask. The extraction was allowed to stay overnight (12 h). The sample was filtered and the filtrate was used for the cyanide determination. To 1 mL of the sample filtrate in a corked test tube, 4 mL of alkaline picrate was added and incubated in a water bath for 5 min. The absorbance was read at 490 nm. The absorbance of the blank (which contained only 1 mL distilled water and 4 mL alkaline picrate solution) was read and used to stabilize the spectrophotometer before taking the

absorbance of the samples. The cyanide content was extrapolated from a cyanide standard curve and the cyanide content calculated using the formula:

$$\text{Cyanide (mg/100g)} = \frac{\text{Absorbance} \times \text{Gradient factor} \times \text{Dilution}}{\text{Weight of sample}}$$

The follin-Denis Spectro photometric method as described by Pearson (1976) was used to determine the tannin content in the samples. The absorbance of the developed color was measured at 760 nm wavelength with the reagent blank set at zero, using GENWAY Model 6000 electronic spectrophotometer.

The phenol content was determined by the method described by Singleton *et al.* (1999). Phenol was extracted by filtering 0.2 g of the sample dissolved in methanol. Then, 1 mL of the filtrate was mixed with 1 mL of Folin Ciocalteu reagent and 2 mL of 20% Na<sub>2</sub>CO<sub>3</sub> solution was added. The intensity of the developed color was measured at 560 nm using GENWAY Model 6000 electronic spectrophotometer. The standard phenol value was likewise determined and the phenol content in the samples calculated from the relation:

$$\text{Phenol content (mg/100g)} = \frac{\text{Au}-\text{Ab} \times \text{C} \times \text{D}}{\text{AS}-\text{Ab}} \times \frac{100}{1}$$

Where:

- Au = Absorbance of the test sample
- Ab = Absorbance of blank
- As = Absorbance of standard phenol
- C = Concentration of standard phenol
- D = Dilution factor of any

**Data analysis:** Data were analyzed for statistical significance by one-way analysis of variance, using the Students ‘t’ test for the comparison of means. Difference in the mean values (n = 2) obtained from duplicate test of each sample) at p<0.05 were regarded as significant. All data were expressed as Mean±SD.

## RESULTS

The antinutrients (mg/100 g) in the rind and seed, respectively viz: saponin (3.0±0.03, 2.31±0.01), alkaloid (1.39±0.00, 0.36±1.03), tannins (1.33±0.01, 0.61±0.01), phenol (0.53±0.00, 0.12±0.01) and flavonoid (2.87±0.00, 2.03±0.02) were comparably higher in the rind than in the seed (Table 1). The difference though was not significant (p>0.05).

As shown in Fig. 1, 2 and 3, the content (mg/100 g) in the seed for cyanide (0.79±0.01), phytate (0.63±1.00) and oxalate (0.09±0.00) was higher (p>0.05) than that in the rind for cyanide (0.00±0.00), phytate (0.46±0.00) and oxalate (0.08±0.01).

Table 1: Antinutrients

Parameter	Rind (mg/100 g)	Seed (mg/100 g)	Difference (mg/100 g)
Saponin	3.0±0.03	2.31±0.01	±0.69
Alkaloid	1.39±0.00	0.36±0.00	±1.03
Tanin	1.33±0.01	0.61±0.01	±0.72
Phenol	0.53±0.00	0.12±0.01	±0.41
Flavonoid	2.87±0.00	2.03±0.02	±0.84

Result = Value ±SD of duplicate determinations. The difference was not significant (p>0.05)

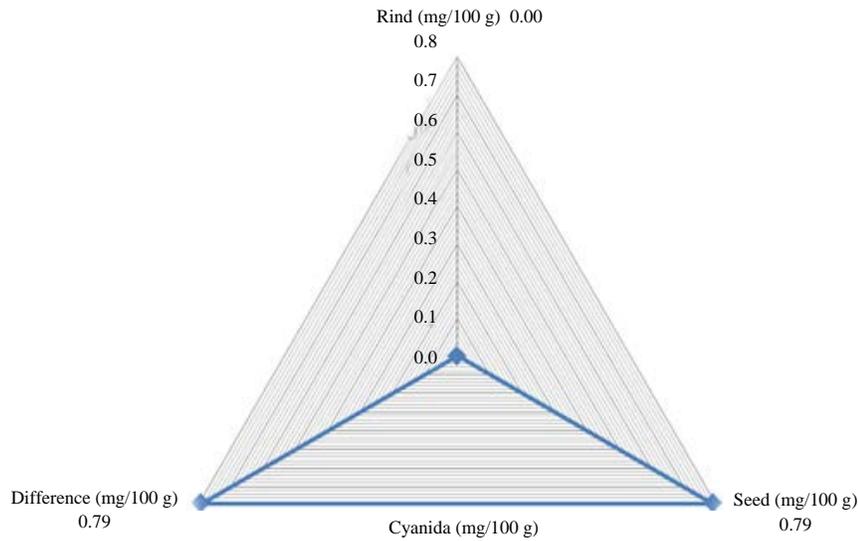


Fig. 1: Cyanide content (mg/100 g) of the watermelon (*Citrullus lanatus*) rind and seed result = value±SD of duplicate determinations. The difference was not significant ( $p>0.05$ )

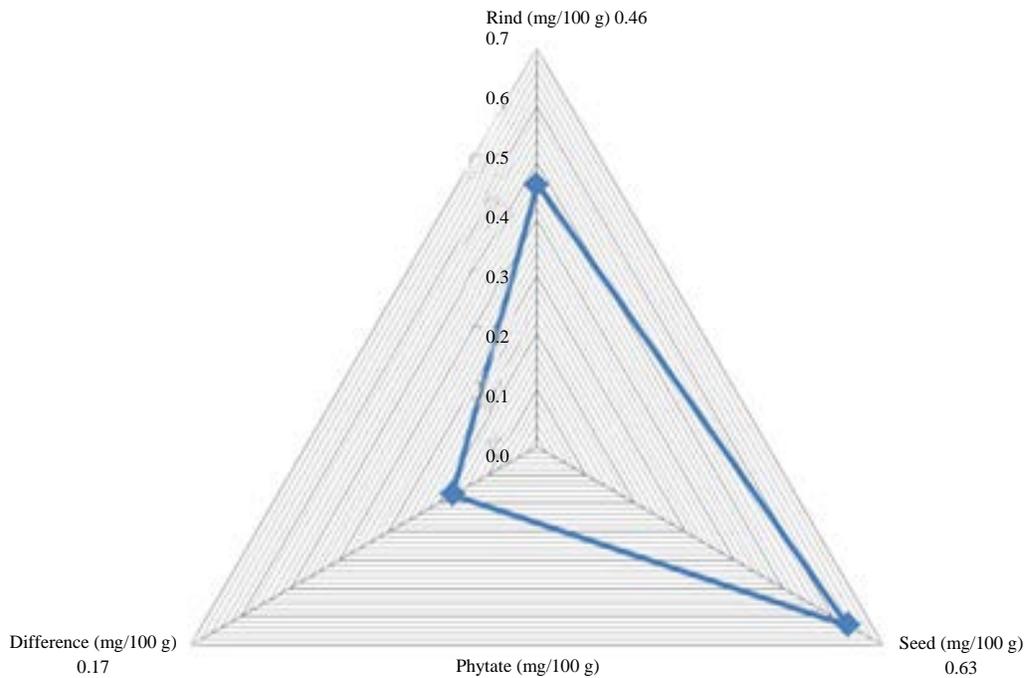


Fig. 2: Phytate content (mg/100 g) of the watermelon (*Citrullus lanatus*) rind and seed result = value±SD of duplicate determinations. The difference was not significant ( $p>0.05$ )

## DISCUSSION

The rind and seed of watermelon (*Citrullus lanatus*) are usually discarded as food wastes in Nigeria. Harnessing food wastes utilization in diets and drugs could improve food supply, health and the environment while the knowledge of antinutrients composition in a food provides an idea

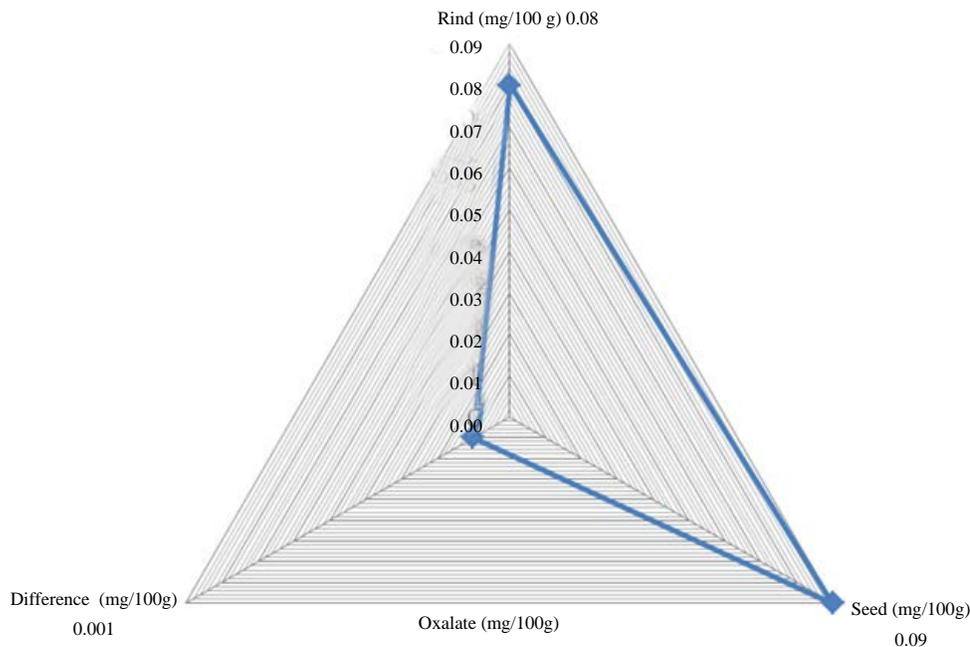


Fig. 3: Oxalate content (mg/100 g) of the watermelon (*Citrullus lanatus*) rind and seed result = value±SD of duplicate determinations. The difference was not significant ( $p>0.05$ )

of the pharmacologic, dietary and toxic potentials of the food, warranting this study. The antinutrients (mg/100 g) viz: saponin, alkaloid, tannins, phenol and flavonoid were comparably higher in the rind than in the seed (Table 1). The saponin content in the samples were comparably lower than the value ( $6.0\pm 0.06$  mg/100 g) reported for *Punica granatum* seeds by Dangoggo *et al.* (2011) and the range ( $18.7\pm 0.31$ - $19.9\pm 0.67$  mg/100 g) reported for *Solanum incanum* by Auta *et al.* (2011) but higher than the value range, though measured in percentages ( $0.13\pm 0.03$ - $0.37\pm 0.03$ ) reported for *Treculia africana* seeds in Ijeh *et al.* (2010). Saponins have bitter taste which could be associated with pharmacologic potentials, including hemolytic activities (Sodipo *et al.*, 2000) and beneficial effects on blood cholesterol levels, bone health, cancer and the stimulation of the immune system (Adeolu and Enesi, 2013).

Alkaloids (especially at low concentration) are therapeutically significant natural plant products owing to their analgesic, antispasmodic and antibacterial properties (Adeolu and Enesi, 2013). The alkaloid content in the rind was slightly higher than, whereas that in the seed compared with, the value range, though in percentage ( $0.35\pm 0.05$  to  $0.58\pm 0.08\%$ ) reported for *Treculia africana* seeds (Ijeh *et al.*, 2010). The tannin content in the rind ( $1.33\pm 0.01$  mg/100 g) and in the seed ( $0.61\pm 0.01$  mg/100 g) was comparably higher than the value ( $0.21\pm 0.02$  mg/100 g) reported by Antia *et al.* (2006) for sweet potatoes leaves, but higher than that for *Treculia africana* seeds in Ijeh *et al.* (2010). In particular, the presence of tannins implied that the samples may have astringent and antimicrobial properties (Adeolu and Enesi, 2013) and may be considered for treating a wide range of ailments, including inflammation, liver injury, kidney problems, arteriosclerosis, hypertension, stomach problem and inhibition of reactive oxygen species (Zhu *et al.*, 1997).

The phenol content in the seed ( $0.12\pm 0.01$ ) was slightly lower, whereas that in the rind ( $0.53\pm 0.00$ ) compared with, the range ( $0.45\pm 0.02$  to  $0.82\pm 0.00\%$ ) reported for processed and

unprocessed *Treculia africana* seed (Ijeh *et al.*, 2010). Phenol functions as antimicrobial compound and protects plants from pathogens (Okwu and Okwu, 2004). Thus, the phenol in the samples could indicate their apparent antimicrobial potential, which could be considered in the treatment of typhoid fever and other bacterial infections (Adeolu and Enesi, 2013). The result showed that the Flavonoid content in the samples (Table 1) was lower than the range ( $36.8 \pm 1.20$ - $39.6 \pm 0.02$  mg/100 g) in the raw and processed *Solanum incanum* (Auta *et al.*, 2011) but compared with that, though in percentage ( $2.15 \pm 0.05$ ) for roasted-dehauled *Treculia africana* seed (Ijeh *et al.*, 2010). Flavonoids have antioxidant, antifungal and antibacterial properties, thus the availability of flavonoid in the samples suggests that their use may offer protection against ailments related to free radicals, bacterial and fungal activities (Adeolu and Enesi, 2013).

The antinutrient content (mg/100 g) in the seed for cyanide, phytate and oxalate was higher than that in the rind (Fig. 1, 2 and 3). There was no cyanide in the rind while the amount in the seed ( $0.79 \pm 0.01$  mg/100 g) was comparably much lower than the value ( $30.24 \pm 0.02$  mg/100 g) in sweet potatoes leaves (Antia *et al.*, 2006). The phytate content (mg/100 g) in the samples was lower than the value ( $1.44 \pm 0.01$ ) reported by Antia *et al.* (2006) for sweet potatoes leaves. The result revealed low level of oxalate in both samples when compared with other plants seeds including *Bucchozia coricea* (1.06 mg/100 g) in Amaechi (2009), *Solanum nigrum* (58.81 mg/100 g) in Akubugwo *et al.* (2007), *Gnetum africanum* (209.00 mg/100 g) in Ekop (2007), *Solanum incanum* ( $22.4 \pm 0.21$ - $23.0 \pm 0.01$  mg/100 g) in Auta *et al.* (2011), sweet potatoes leaves ( $308.00 \pm 1.04$  mg/100 g) in Antia *et al.* (2006) and *Treculia africana* ( $8.01 \pm 0.04$  to  $11.37 \pm 0.10$  %) in Ijeh *et al.* (2010). The absence of cyanide in the rind is nutritionally noteworthy in view of the general cyanide toxicity. Phytates provide antioxidant effect and the presence of phytate in the samples is suggestive of antioxidant benefit following their consumption (Adeolu and Enesi, 2013). Generally, the recorded difference in the antinutrients content in the rind and seed samples was not significant ( $p > 0.05$ ), hence negligible. The lower antinutrients in the samples as compared with that of earlier studies may imply lower toxic risk. Antinutrients (especially at higher quantity) could be toxic by forming insoluble complexes with nutrients and reducing their bioavailability and absorption (Zhu *et al.*, 1997; Akindahunsi and Salawu, 2005; Daniel and Cemaluk, 2011; Adeolu and Enesi, 2013). However, antinutrients are heat labile and volatile (Egbonu *et al.*, 2014) hence this unwanted property may be reduced or removed by simple processing, including cooking (Akwaowo *et al.*, 2000), warranting further studies.

## CONCLUSION

The preponderance of these antinutrients in a comparatively lower amount in the samples suggests that the watermelon rind and seed may offer pharmacologic and dietary benefits at a possibly lower toxic risk. Thus, the study supports the use of watermelon rind and seed as food and/or as drug in ethnomedication. Further studies to harness and enhance the utilization of watermelon rind and seed in diets and drugs are required to reduce their attendant waste burden in the environment.

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