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COMPARATIVE EVALUATION ON NUTRIENT, ANTI-NUTRIENTS AND PHYTOCHEMICAL CONTENT OF MELON (*Curcubita citrullus L.)*, PIE MELON (*Cucurbita ficifolia)* AND WATER MELON (*Citrullus lanatus)* SEED FLOURS

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ABSTRACT

The study sought to evaluate the nutrient, anti-nutrients and phytochemical content of melon (curcubita citrullus l.), pie melon (curcubita ficilia) and water melon (citrullus lanatus) seed flours. The melon seeds were dehulled manually and sorted to remove extraneous materials and bad seeds. It was sundried, milled and stored in an air-tight polyethylene bag. Pie melon and watermelon fruits were washed, cut with knife, it was deseeded from pulp, cleaned and washed properly with tap water respectively. They were air-dried, dehulled, sundried, milled and stored in an air tight polyethylene bag. Proximate, mineral, anti-nutrient and phytochemical composition of flour samples were carried out in triplicates using standard methods. One way analysis of variance (ANOVA) and Turkey's test were used to separate and compare the means. Results shows that pie melon was significantly ($p<0.05$) higher in protein (40.24%), ash (5.00%), fat (23.43%), and fibre (4.89%). Watermelon (2.99%) was higher in moisture and carbohydrate (38.61%). Mineral composition of watermelon, pie melon and melon seed shows that calcium (40.00%), potassium (590.00%) and sodium (4.02%) were significantly ($p<0.05$) higher in watermelon while magnesium (42.50%), iron (252.10%) and copper (106.25%) were significantly ($p<0.05$) higher in pie melon. Watermelon was significantly higher in hydrogen cyanide (1.42mg/100g) and oxalate (5.13mg/100g). Tannin was not significantly ($p>0.05$) different among the melon seed varieties though higher in watermelon. Flavonoid (3.00mg/100g) and phenol (0.86mg/100g) was significantly ($p<0.05$) in watermelon while pie melon had the lowest value. The different varieties of melon seeds studied shows that they are all rich in macro and micro nutrient but was significantly higher in pie melon. Pie melon production and consumption should be encouraged among different age groups.

Key words: Pie melon, water melon, melon, nutritional composition

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INTRODUCTION

Developing countries like Nigeria depends on starchy foods as their main staple food and recently to processed foods which contribute to high incidence of non-communicable disease trend as a result of rapid shift from traditional diet to westernized diets (Kelly *et al.,* 2008).

Individuals that consume westernized foods are at risk of increased consumption of preservatives and saturated fats with reduced dietary fiber intake, essential nutrients and bioactive compounds when compared to the recommended nutrient intake (Gupta and Prakash, 2011). Previous study by Amadi *et al*. (2017) reported that inadequate consumption of recommended nutrient intake was because most individuals are not knowledgeable enough on nutrient content of foods couple with poverty which predisposes them to cheap and junk foods with high risk for malnutrition. Protein-energy malnutrition among children in low income families has given rise to morbidity and mortality (Onyezili, 1999). The consequences of malnutrition among under-five children was as a result of 12% of the population consuming inadequate nutrients needed to maintain their full physical health and 47% were unable to reach their genetic potential with 40% of women of child bearing age suffering from anemia (Nwanekezi, 2000). In Nigeria, 28% are underweight, 11% (severely underweight), 42% (stunting), 11% (wasting) and 23% and 4% are severely stunted and wasted respectively among under five children (Murray and Lopez, 1996). This high prevalence of under-nutrition is possibly a factor of inadequate protein source of animal origin and this has led to the research of underutilized oil seeds (ACC/SCN, 2004).

High intake of foods rich in phytochemical has been reported to reduce risk of certain cancers, cardiovascular disease, diabetes mellitus and hypertoxicity (Liu, 2004). Phytochemicals are bioactive compounds of plant origin and are regarded as secondary metabolites (Wang *et al.,* 2013). However, when certain phytochemicals content of food are at critical levels they are regarded as anti-nutrients like tannin, oxalates, saponin, and phytate (Omorayi and Dilworth, 2007). These anti nutrients are natural chemical in foods that when consumed in excess inhibit the absorption of certain minerals. Melon (*Curcubita citrullus L.)* and water melon (*Citrullus lanatus)* belong to the family of cucurbitaceae (Quattrocchi, 2000; Abbah *et al.*, 2014). Melon is generally used as soup thickener and fermented soup condiment (Onyeike and Achere, 2012) while watermelon is taken as fruit. The seeds of watermelon are often discarded but recent studies have tried in evaluating its usefulness as soup thickener (Nzegwu and Rapheal, 2018). Melon seeds are good source of protein, oil and they possess antioxidant, analgesic and anti-inflammatory properties (Gill *et al.,* 2009; Chen *et al.,* 2014). Water melon on the other hand is also good sources of protein, micronutrients and bioactive compounds (Braide *et al.,* 2012; USDA, 2016). Interestingly, pie melon (*Cucurbita ficifolia*) belongs to the curcurbitaceae family with melon and watermelon but has not gained popularity, it is poorly studied and it is gradually going into extinction. It is known as pie melon, fig-leaf gourd or black seed squash. According to USDA (2016) pie melon contains protein (32.80%), ash (4.8%) and fat (32.71%). It contains appreciable amount of micronutrient (USDA, 2016). Previous studies have reported that pie melon has anti-inflammatory, antiviral, anti-ulcer, anti-diabetic and antioxidant potentials (Smith, 2011; Dhiman *et al.,* 2012; Chaturvedi, 2012). Therefore there is need to evaluate the nutrients, anti-nutrients and phytochemical of pie melon (*Cucurbita ficifolia*) and compare it with melon (*Curcubita citrullus L.)*, and water melon seeds (*Citrullus lanatus)*. This will help to create awareness on the nutritional content of pie melon and its use.

MATERIALS AND METHODS

Sourcing of materials

Melon (*Curcubita citrullus L.)* seeds, pie melon *(Cucurbita ficifolia),* and watermelon *(Citrullus lanatus)* fruits were purchased from Relief Market Owerri, Imo state.

Processing of the Materials

Melon seed processing

The melon seed was dehulled manually and sorted to remove extraneous materials and bad seeds. It was sundried for one day, milled with locally fabricated milling machine and stored in an air tight polyethylene bag.

Pie melon and watermelon processing

Pie melon and watermelon fruits was washed, cut with a sterile knife, it was deseed from the pulp, cleaned and washed properly with tap water respectively. They were air dried, dehulled manually and sorted to remove extraneous materials and bad seeds. They were sundried for one day, milled with locally fabricated milling machine and stored in an air tight polyethylene bag.

Nutrients, anti-nutrients and phytochemical analysis

The proximate, mineral, antinutrient and phytochemical content of the flour samples were carried out in triplicates. Moisture content was determined using gravimetric method; protein by micro-kjeldahl method; ash by furnace incineration gravimetric method; lipid by Soxhlet extraction an fibre were all determined as described by (AOAC, 2005). Carbohydrate was calculated by difference (100 - %Moisture + Ash+ Protein+ Fibre+ Fat). Mineral content like potassium and sodium was determined by flame photometry; calcium and magnesium by colorimetric method; zinc, iron and manganese by atomic absorption spectrophotometric method by AOAC (2005). Tannin and oxalate were determined by Folin-Denis spectrophotometry method as described by Pearson (1979); flavonoid as described by Harborne (2005). The phenol content was determined using Folin-Ciocatean spectrophotometric method (AOAC, 2005).

Statistical Method

Means and standard deviation were calculated for all the samples. One way analysis of variance (ANOVA) and Turkey's tests were used to separate and compare the means.

RESULTS

Proximate composition of watermelon, pie melon and melon seed flours

Pie melon was significantly ($p<0.05$) higher in protein (40.24%), ash (5.00%), fat (23.43%) and fibre (4.89%). Watermelon (2.99%) was higher in moisture and carbohydrate (38.61%).

Mineral composition of watermelon, pie melon and melon seed flours

Mineral composition of watermelon, pie melon and melon seed shows that calcium (40.00%), potassium (590.00%) and sodium (4.02%) were significantly ($p<0.05$) higher in watermelon while magnesium (42.50%), iron (252.10%) and copper (106.25%) were significantly ($p<0.05$) higher in pie melon (Table 2).

Anti-nutrient composition of watermelon, pie-melon and melon seed flours

Watermelon was significantly ($p<0.05$) higher in tannin (0.18mg/100g), hydrogen cyanide (1.42mg/100g) and oxalate (5.13mg/100g) and lower in pie melon though not significantly ($p>0.05$) different from melon except in melon seed flour (Table 3).

Phytochemical composition of watermelon, pie melon and melon seed flours

Flavonoid (3.00mg/100g) and phenol (0.86mg/100g) was significantly ($p<0.05$) while pie melon had the lowest value.

DISCUSSION

The moisture content of the watermelon, pie melon and melon of the present study were similar and lower than 70% (Jacob *et al.,* 2015) on melon and other oil seed like cotton seeds and sunflowers seeds (FAO, 2000). However, the study was similar with (Abiodun and Adeleke, 2010) on melon seeds varieties. Moisture content has been used as index of evaluating the keeping quality of foods (Ihekoronye and Noddey, 2011). Pie melon was highest in ash content and was comparable with (6.7%) reported by (Jacob *et al.,* 2015) on melon seeds. The study was consistent with (USDA, 2016) on pie melon and watermelon ash content. Pie melon had the highest protein content while watermelon was the least. All the melon seeds studied were higher than 27.48% on melon seed (Bankole *et al.,* 2005), 25.33% on watermelon seed (Akasu *et al.,* 2015) and 16.33% and 17.75% on varieties of watermelon (Tabiri *et al.,* 2016) but was consistent with 37.82g and 32.6% (Ibeanu *et al.,* 2012; Tak and Jain, 2016) on watermelon respectively. The study shows that the protein content of watermelon, pie melon and melon seed flours were higher than recommended nutrient intake by (FAO/WHO/UN, 1985) and is capable of providing the body with the essential amino acids required for growth (Igwenyi and Azoro, 2014). The fat content of the three varieties of melon studied was lower than (USDA, 2016; Jacob *et al.,* 2015) but watermelon and pie melon was consistent with (Ibeanu *et al.,* 2012; Tak and Jain, 2016) respectively. Oyeleke (2012) reported a fat content of 47.92% on watermelon which was higher than that obtained in this study. However the study revealed that melons of cucurbit family are good sources of oil and protein. Crude fibre content of pie melon was highest and consistent with (Nzeagwu and Rephael, 2018). Carbohydrate content was of the melon seed studied had similar values though lower in pie melon but higher in watermelon. The implication

of the study was that the melon seed varieties could be used for individuals on low carbohydrate food.

Mineral Composition of the melon varieties

The average iron content on this study was similar though higher than that report by (Jacob *et al.,* 2015) (144.70%) on melon seed flour. But the present study was not consistent with previous studies on melon seeds (Milala *et al.,* 2018; Umar *et al.,* 2013). The disparities could be as a result of different varieties used. Iron helps in heamoglobin formation and transfer of oxygen and carbon dioxide from one tissue to another (McDonald *et al.,* 2010). The calcium content was higher in watermelon while pie melon had the lowest calcium content. The study was similar with (Egbuonu, 2015) on watermelon content but watermelon and melon had higher values than his study. However, the calcium content was lower than (USDA, 2014) on melon seeds. On the other hand, the calcium content of the watermelon and melon seed in the present study could be compared with (Umar *et al.,* 2013).

The manganese content of the sample was higher than (22.73%) reported by Jacob (2015), 8.94mg/100g and 20.4mg/100g on watermelon and melon respectively (Nzeagwu and Raphael, 2018). Manganese is very important in calcium metabolism in bones and also involved in prevention of circulatory diseases. Manganese plays important role in the transfer of oxygen from lungs to cells and activation of enzymes reactions concerned with carbohydrate, fat and protein metabolism (Payne, 2011). The magnesium content of this present study was higher than (20.46%) reported (Umar *et al.,* 2013) on melon seeds but lower than 526.58mg/100g (Ibeanu *et al.,* 2012) on watermelon and 135.50mg/100g on wild melon (Umar *et al.,* 2013). The study was consistent (359.3mg/100g) with (USDA, 2016) on magnesium content of pie melon in the present study. Sodium content was lowest in melon seed but higher in watermelon. The value of sodium in the present study was lower than (13.0mg/100) in egusi melon as reported (Ojineh et al., 2008) and 23.15mg/100g (McDonald *et al.,* 2010) though higher than 0.12mg/100g and 0.23mg/100g for watermelon and melon seed respectively (Nzeagwu and Raphael, 2018). Potassium content of the melon seeds were high though higher in watermelon. The study agrees with (Egbuonu, 2015) on watermelon and pie melon of the present study but was higher (524.0mg/100g) than melon. However, Umar *et al.* (2013) and Ibeanu *et al.* (2012) reported higher values (2962 and 705.37mg/100g) respectively than that obtained from the present study. Potassium is beneficial in reducing the risk of hypertension and may help to provide the nutrient intake of potassium. Only plants with more than 200mg of hydrocyanic equivalent acid per 100mg fresh weight are considered dangerous (Betancur-Anocona *et al.,* 2008). From the result obtained in this study, the concentrations of oxalate, tannin and hydrocyanic acid in the three seed flours were low to cause any health risk in human.

The anti nutrients; tannin, oxalates and hydrogen cyanide were low in the present study but were higher in watermelon. Tannin content was within the safe limit of 0.15 to 0.20mg (Ukam *et al.,*

2016), though higher than (Nzeagwu and Rapheal, 2018; Jacob *et al.*, 2015). The anti-nutrients studied in the present study were lower than oxalate (26.40mg/100g), tannin (39.40mg/100g) and hydrocyanic acid (1.56) as reported by (Jacob *et al.*, 2015). Phytochemicals in the melon seed varieties were higher in watermelon seeds and lower in pie melon seeds but was inconsistent with Nzeagwu and Rapheal (2018) who reported that phenol and flavonoid were higher in melon than watermelon seeds.

CONCLUSION

The study revealed that the three varieties of melon were rich in both macro and micronutrient but was higher in pie melon. The melons were low in anti-nutrients while the phytochemicals were also of appreciable amount. The cultivation and consumption of pie melon should be encouraged. Also, pie melon should be used in production of other soup products.

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Table 1: Proximate composition of watermelon, pie melon and melon seed flours (%)

Samples	Moisture	Ash	Protein	Fat	Crude fiber	Carbohydrate
Watermelon	2.99^{a}±0.02	4.00^{b} ±0.01	34.12^{c} ±0.02	17.64^{b}±0.26	2.64^{c}±0.02	38.61^{a}±0.23
Pie melon	2.92^{a} ±0.02	5.00^{a} ±0.02	40.24^{a} ±0.02	23.43^{a} ±0.31	4.89^{a}±0.03	33.52^{c}±0.29
Melon	2.91^{a} ±0.02	3.00^{c} ±0.00	35.16 ^{b}±0.07	18.66^{c}±0.21	3.97^{b}±0.03	36.30^{b}±0.11

Mean values of the three samples **(**±) standard deviation, mean score with different superscript letter on the same column are significantly different (P<0.05).

Table 2: Mineral composition of watermelon, pie melon and melon seeds (mg/100g)

Samples	Calcium	Magnesium	Potassium	Manganese	Iron	Copper	Sodium
Watermelon	40^{a}±0.02	150^{c}±0.18	590^{a}±0.01	30.12^{b}±0.53	113.12^{c}±1.94	23.85^{c}±0.42	4.02^{a}±0.00
Pie melon	20^{c}±0.00	340^{a}±0.00	510^{ab}±0.01	42.50^{a}±1.00	252.10^{a}±2.40	106.25^{a}±1.06	3.25^{b}±0.39
Melon	30^{b}±0.00	260^{b}±0.00	410^{b}±0.00	29.35^{c}±0.35	167.50^{b}±1.86	41.50^{b}±0.35	2.21^{c}±0.40

Mean values of the three samples **(**±) standard deviation, mean score with different superscript letter on the same column are significantly different (P<0.05).

Table 3: Antinutrient composition of watermelon, pie melon and melon seed flours (mg/100g)

Samples	Tannin	HCN	Oxalate
Watermelon	0.18^{a}±0.00	1.42^{a}±0.01	5.13^{a}±0.01
Pie melon	0.16^{a}±0.00	1.00^{b}±0.00	3.09^{c}±0.00
Melon	0.17^{a}±0.00	1.21^{b}±0.00	4.31^{b}±0.00

Mean values of the three samples **(**±) standard deviation, mean score with different superscript letter on the same column are significantly different (P<0.05).

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Table 4: Phytochemical composition of watermelon, pie melon and melon seed flours (mg/100g)

Samples	Flavonoid	Phenol
Watermelon	3.00^{a}±0.02	0.86^{a}±0.00
Pie melon	1.47^{c}±0.72	0.43^{c}±0.00
Melon	1.81^{b}±0.85	0.64^{b}±0.02

Mean values of the three samples **(**±) standard deviation, mean score with different superscript letter on the same column are significantly different (P<0.05).