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Effects of cooking on chemical and phytochemical compositions of raw and cooked melon (*Citrullus colocynthis* L) and walnut (*Tetracarpidium conophorum* L) seeds

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Abstract

Effects of cooking on proximate, phytochemicals and selected vitamins composition of melon and walnut were investigated in this study. Melon Seeds (MS) and Walnut Seed (WS) weighing 500 g each were obtained from open market and each was halved into two. One half was boiled for one hour and oven dried at 60°C for 48 hours till constant weight was attained to obtain treated melon seed and treated walnut seed, respectively. The other halves were left un-cooked and were labelled uncooked melon seed and uncooked walnut seed, respectively. In MS, cooking reduced the crude protein, crude fibre and ash compositions but increased the moisture and ether extracts contents significantly ($p<0.05$). In WS, cooking reduced the crude protein and crude fibre but increased the ether extracts and moisture significantly ($p<0.05$) without any effect on ash contents ($p>0.05$). Aside from flavonoids which increased ($p<0.05$), other phytochemicals in MS were significantly reduced by cooking ($p<0.05$). Also, there were reduced tannins, steroids, terpenoids and alkaloids. The phytates and flavonoids increased significantly ($p<0.05$) while saponins composition remained significantly unaffected ($p>0.05$) by cooking. Ascorbic acid and tocopherol in MS as well as β-carotene and ergosterol contents were not affected significantly ($p>0.05$) by cooking. However, the β-carotene of 0.16 and ergosterol of 0.57 in raw MS reduced significantly ($p<0.05$) to 0.13 and 0.25 mg/kg, respectively by cooking. Also, tocopherol and ascorbic acid with respective values of 69.40 and 4.41 mg/kg in WS were lowered significantly ($p<0.05$) by cooking to 58.65 and 3.95 mg/kg, respectively. Processing reduced antinutrients in melon and walnut seeds and improve their nutrient sources.

Keywords: Walnut, melon seeds, Vitamins, Flavonoids, Proximate composition.

Introduction

Seeds are of nutritional importance as they supply nutrients required for growth and development in human and animals. Despite the fear of anti-nutritional factors in some of the crops and seeds. Studies (Liu, 2004), showed that the phytochemicals present in plants have distinctive anti-nutrients in reducing several deadly disease (Agte *et al*., 2004). Plants also contain chemical compounds such as saponins, tannins, oxalates, phytates, trypsin inhibitors and cyanogenic glycosides commonly known as secondary metabolites, which are biologically active (Soetan and Oyewole, 2009). Secondary metabolites are applicable in nutrition and pharmacy as biologically-active agents (Soetan and Oyewole, 2009). Walnut and melon seeds are also known to have high amounts of essential nutrients, vitamins, minerals and fatty acids and fibre (Gafar and Itodo, 2011). Walnut is one of the most widely used nuts among the dessert nuts. It belongs to the Jugludaceae family. African walnut is an edible seed of any tree of the genus *Euphorbiaceae,* especially, the *Tetracarpidium conophorum*, found in

Nigeria and Cameroon. It is a climbing shrub of 3.05-6.10 m long, cultivated principally for the nuts which are cooked and consumed as snacks or dessert (Adebona *et al*.,1998). It is known in the South-East Nigeria as *ukpa* (Igbo), Western Nigeria as *awusa* or *asala* (Yoruba), South-South Nigeria as *Okhue* (Edo). Walnut seed, is of great potentials, the secondary metabolites in the seeds have shown to be biologically active (Zenk, 1991). These secondary metabolites are widely applied in nutrition and pharmacology (Soetan, 2008). The nut is rich in fat, protein, minerals and vitamins, though the minerals content and percentage oil content of the nut varies depending on its cultivar,soil parameters and climatic conditions of where it is grown (Ogunsua and Adegbona, 1993). Alkaloids present in nuts give a bitter taste which is usually observed upon drinking water immediately after eating the nuts (Edem *et al*, 2009). Melon is universally grown in tropical Africa for its seed (Alkofahi *et al.,* 1996). It is reported to have hepatoprotective activity (Dar *et al.,* 2012), anti-arthritic activity (Kachhawah *et al.,* 2016), good physiochemical and fatty acid profile (Oluba *et al.,* 2008). Melon is popular in Nigeria because of its edible seeds that is commonly used in the preparation of local soups or stew prepared with or without vegetables (Oloko *et al*., 2006; Ogbonna, 2007; Jackson *et al*., 2013). Melon is rich in oil and protein, comprising about 50% oil and 35% protein,among major foods only peanut has such high oil content (Ojie *et al*., 2008). Phytochemicals present in walnut seed have been determined (Nwaoguikpe *et al*., 2012). Also, the chemical compositions of melon seed have been documented (Jacob *et al*., 2015). However, information on the effect of cooking on the proximate composition and the phytochemical constituents is scanty. It is therefore necessary to assess their nutritional potential. Hence, this study was aimed at determining the proximate and phytochemicals present in walnut and melon seed meal as affected by cooking.

Materials and methods

Preparation of samples

Melon seeds and walnut kernel were purchased from Bodija market in Ibadan, Nigeria. The melon seed and walnut kernel were thoroughly washed, before dividing both into two parts. A part of both melon and walnut were cooked seperately in boiling water at 100 ^{O}C for one hour. Melon was dehulled while walnut was dekerneled then their seeds were removed and oven dried at 60 ^{O}C for 48 hours till constant weight were attained to obtain treated melon seed (TMS) and treated walnut seed (TWS), respectively. Samples were ground separately while the other halves were left un-cooked and labelled uncooked melon seed (UMS) and uncooked walnut seed (UWS), respectively and kept for analyses.

Chemical determinations

Proximate analysis of raw and cooked samples were carried out in triplicates using the official methods (AOAC, 2000). Alkaloids were determined according to Okwu and Josiah (2006). Flavonoids were determined with the methods of Okwu (2005), saponins were estimated as described (Obadoni and Ochuk, 2001). Phytates were determined using the method described by Wheeler and Ferrel (1971). Tannins were quantified using the method of Sofowora (1993). Phenol was measured using the Folin Ciocalteu reagent (Mc Donald *et al*., 2001) while terpenoids and steroid were determined as described (Pearson, 1973). Vitamins C and E as well as provitamins A and D compositions were quantified as described (Okwu, 2004).

Statistical analysis

Data were subjected to descriptive statistics and studentised T test analysis (SAS, 2002)

while means were separated at $\alpha_{0.05}$.

Results

The proximate composition of raw and cooked melon seeds are shown in Table 1. Crude protein reduced significantly ($p<0.05$) from 30.78 % in raw melon to 27.63 % in cooked melon seed. Also, crude fibre and ash reduced significantly ($P<0.05$) from 3.50 to 3.10 % and 3.50 to 3.10 %, respectively after cooking for raw and cooked melon, respectively. Moisture content increased significantly from 9.68 to 10.20 % while ether extract likewise increased significantly ($p<0.05$) from 59.88 in raw melon seed to 61.10 % in the cooked melon seed.

Table 1: Proximate composition (g/100g) of raw and cooked melon seed

Parameters(%)	Raw melon	Cooked melon
Crude Protein	30.78 ±0.02^{a}	27.63±0.02^{b}
Ether extract	59.88 ±0.02^{b}	61.10±0.02^{a}
Crude Fibre	3.50±0.02^{a}	3.10±0.01^{b}
Ash	3.50 ±0.01^{a}	3.10±0.01^{b}
Moisture	9.68±0.02^{b}	10.20±0.01^{a}

$^{ab-}$ Means with different superscripts on each row are significantly different ($P<0.05$)

Proximate composition of raw and cooked walnut seed are shown in Table 2. *Moisture content increased significantly ($p<0.05$) from 8.8 % in raw walnut to 11.5 % after cooking Similarly, ether extract also increased from 26.78 % to 44.59 % after cooking.* There was significant reduction ($p<0.05$) in crude protein from 32.2 in the raw walnut to 23.8 % , when cooked. The ash values were not affected significantly ($p>0.05$) by cooking. Crude fibre values reduced significantly ($p<0.05$) after cooking from 5.39 % in raw walnut to 4.10 % in raw and cooked walnut.

Table 2: Proximate composition (g/100g) of raw and cooked walnut seed meal

Parameters(%)	Raw walnut	Cooked walnut
Crude Protein	32.24±0.01^{a}	23.78±0.02^{b}
Ether extract	26.78±0.01^{b}	44.59±0.01^{a}
Crude Fibre	5.39±0.01^{a}	4.10±0.02^{b}
Ash	5.38 ±0.02	5.30±0.02
Moisture	8.78±0.02^{b}	11.50±0.01^{a}

$^{ab-}$ Means with different superscripts on each row are significantly different ($P<0.05$)

Phytochemical composition of raw and cooked melon seed meal is presented in Table 3. The phytochemical constituents (tannin, steroid, saponin, terpenoid, phytate, alkaloids and phenol) were all lowered significantly ($p<0.05$) due to cooking. However, only flavonoids increased significantly from 20.59 in raw melon seed to 21.13mg/100g) in cooked melon.

Table 3: Phytochemical composition of raw and cooked melon seed meal

Parameters(mg/100g)	Raw Melon	Cooked Melon
Tannin	22.92 ± 0.20[a]	17.46 ± 1.09[b]
Steroid	16.26 ± 0.31[a]	13.53 ± 0.92[b]
Saponin	23.22 ± 0.01[a]	19.22 ± 0.02[b]
Terpenoid	37.02 ± 0.02[a]	22.44 ± 0.02[b]
Phytate	0.70 ± 0.002	0.73 ± 0.001
Alkaloids	5.23 ± 0.01[a]	1.07 ± 0.02[b]
Flavonoids	20.59 ± 0.01[b]	21.13 ± 0.02[a]
Phenol	1.56 ± 0.01[a]	0.46 ± 0.03[b]

[ab-] Means with different superscripts on each row are significantly different (P<0.05)

Effect of cooking on phytochemical composition of walnut seed meal is shown in Table 4. Tannin, steroid, terpenoid, alkaloids and phenol values reduced significantly ($p<0.05$) due to cooking, the phytate and flavonoids increased significantly ($p<0.05$) while saponin was not affected significantly ($p>0.05$) by cooking.

Table 4: Phytochemical composition of raw and cooked walnut seed meal

Parameters(mg/100g)	Raw Walnut	Cooked Walnut
Tannin	20.82 ± 0.58[a]	16.92 ± 0.42[b]
Steroid	16.95 ± 0.62[a]	14.90 ± 0.32[b]
Saponin	24.91 ± 0.02	24.62 ± 0.01
Terpenoid	32.91 ± 0.01[a]	23.94 ± 0.02[b]
Phytate	0.49 ± 0.002[b]	0.81 ± 0.002[a]
Alkaloids	13.06 ± 0.02[a]	9.32 ± 0.02[b]
Flavonoids	12.51 ± 0.01[b]	21.13 ± 0.02[a]
Phenol	1.73±0.002[a]	0.91±0.001[b]

[ab-] Means with different superscripts on each row are significantly different (P<0.05)

The vitamin and provitamin content (mg/100g) of raw and cooked melon seed meal are shown in Table 5. The tocopherol and ascorbic acid compostions of melon seeds were not significantly affected ($p>0.05$) by cooking. However, β carotene value reduced significantly ($p<0.05$) from 0.16 in raw melon seeds to 0.13 mg/kg due to cooking. Similarly, ergocalcipherol composition also decreased significantly ($p<0.05$) from 0.57 in the raw melon to 0.25 mg/kg after cooking.

Table 5: Vitamin and provitamin composition (mg/kg) of raw and cooked melon seed meal

Parameters	Raw Melon	Cooked Melon
β carotene	0.16±0.01[a]	0.13±0.01[b]
Ergocalcipherol	0.57±0.06[a]	0.25±0.05[b]
Tocopherol	3.07±0.01	3.06±0.02
Ascorbic acid	1.56±0.07	1.47±0.16

[ab-] Means with different superscripts on each row are significantly different (P<0.05)

The vitamin and provitamin composition in the raw and cooked walnut seed meal are presented in Table 6. The β carotene and ergosterol compositions were were not significantly affected (P>0.05) by cooking. Conversely both tocopherol and ascorbic acid compositions in the raw walnut which were 69.40 and 4.41 reduced significantly (p<0.05) to 58.65 and 3.95 mg/kg, respectively in cooked walnut seeds.

Table 6: Vitamin and provitamin (mg/kg) compositions of raw and cooked walnut seed meal

Parameters	Raw Walnut	Cooked Walnut
β carotene	2.67± 0.17	2.48±0.15
Ergocalcipherol	0.51±0.11	0.55±0.05
Tocopherol	69.40±0.10[a]	58.65±0.24[b]
Ascorbic acid	4.41±0.10[a]	3.95±0.26[b]

[ab-] Means with different superscripts on each row are significantly different (P<0.05)

Discussion

Raw and cooked melon seed contained relatively higher moisture content than reported for the raw melon (Abiodun and Adeleke, 2010). This could be attributed to cooking due to absorption of water by simple diffusion. There was decreased ash content of melon seed from 3.50 to 3.10 % after cooking which was lower than the range of 3.35 to 4.89 % reported for melon seeds (Enlinge *et al*., 2012). The reduced crude protein after cooking was perhaps due to thermal reduction as a result of denaturation of some nitrogenous compound during processing (Apeh *et al*., 2014). In the literature, crude protein range of 3.2 to 43.1 % were reported for fruits and nuts (Achinewhu *et al*., 1995). The ether extract value of 61.10 % was higher than 48.9 %, earlier documented (Oyeleke, 2003). Melon are called oil seeds and are known to contain 43-55 % oil (Ige *et al*., 1984), which provides body the vital energy when consumed and promote fat soluble vitamin absorption (Boget *et al*, 1994). The crude protein reduction due to walnut cooking from 32.24 to 23.78 % was adduced to leaching of nutrient into cooking water in line with the earlier observation by authors (Adeyeye, 2010; Adeniyan *et al*., 2013). Conversely, Eugene *et al*. (2015) obtained a lower crude protein range of 26.2 to 27.7 %. The increased ether extract composition from 26.78 to 44.59 % could be explained by the likely distruption of cell structure and membrane partitions of the seed due to cooking which caused the fat to melt and easily extractable (Ayoola *et al*.,2011). Eugene *et al*. (2015) recorded a higher ether extract range of 49.8 to 51.7 % than observed in this study. Oils in walnut are rich source of healthy mono-saturated fats and omega-3-fatty acid (Malteljan, 2015). The relatively low moisture content of raw walnut could make it more durable by having higher storage duration compared to cooked walnut.

Cooking reduced phytochemical composition in melon seed except for the flavonoids. The observed higher values of flavonoids as reported by Braide *et al*. (2012) could be because of different specie and cultivar area. Phenol concentration in melon was higher than other legumes (Oboh, 2006). Other predominant phytochemical of melon seed are terpenoid, flavonoids,saponin and tannin which exhibit various biological properties as antioxidant (Latha *et al*., 2003). Reduction in saponin after cooking would be because of the detergent properties and content of

both water and fat soluble components (Manika *et al*., 2015). Phenols are natural antioxidant which inhibit oxidation of unsaturated lipids and prevents formation of oxidised low density lipoproteins that cause cardiovascular diseases *in vivo.* Alkaloids content of melon seed reduced after cooking and this could imply positively on human subjects to consuming it (Kalu *et al*., 2011). Walnut contained high levels of flavonoids which are known for their analgestic, anti-microbial and antibacterial properties (Dreosti, 2000). The presence of tannins in cooked walnut confers astringent nature invaluable for the treatment of diarrhoea and dysentery (Dharmananda, 2003). Phytate concentration was more in walnut than melon seed which also increased significantly after cooking. The observed insignificant effect of cooking on tocopherol and ascorbic acid in melon seed was contrary to the report of Ejoh and Ketiku (2013). This could be due to the different processing methods. Walnut has higher ascorbic acid than melon indicating that walnut in raw and cooked forms could be useful as preservatives of dietary materials (Okonkwo and Ozoude, 2014). Vitamins have diverse biochemical functions, vitamin D have hormonal functions as regulators of mineral metabolism or regulator of cell and tissue growth. Provitamin A functions as an antioxidants for growth, while vitamin C and E are antioxidants which could be important in the prevention or mitigation of the formation of carcinogenic substances in diets (Hunt *et al*., 1980). Antioxidants repair free radical damages to the cells (Okaraonye and Ikewuchi, 2009). Therefore, the presence of antioxidant in relatively high concentration suggests that both seeds could be deployed as vitamin supplements to obviate *in vivo* oxidative stress conditions. Tocopherol concentration was higher in walnut than in melon seeds, thus perhaps increasing the use of walnut in Southern Nigeria in ethno-medicine for male fertility (Ajaiyoba and Fadare, 2006).

Conclusion

Cooking lowered the phytochemical and vitamin compositions of walnut and melon seeds. Most of the antinutrients leached into cooking water. These low concentration of nutrients in both seeds were possitive indications of their potentialities as supplements for *in vivo* anti-oxidants as well as preservatives in feeds and foods.

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