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Glycemic Indices, Possible Antidiabetic Potentials and Phenolic Contents of some Indigenous Green Leafy Vegetables (GLVs)

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ABSTRACT

Generally, green leafy vegetables (GLVs) are consumed cooked. In this study, the effect of cooking on glycemic indices (soluble sugar, starch, amylose/amylopectin contents), α-amylase and α-glucosidase inhibitory potentials and phenolic content of some indigenous GLVs (Curry, Bitter, Water, Scent, Fluted pumpkin, Bush-buck, Wild spinach, False cubeb and Bologi leaves) were determined. One Portion of each sample was cooked for 5 minutes in hot water and dried alongside the raw before pulverized. The free sugar, starch, amylose, and amylopectin content of the raw samples ranged from 7.86 - 15.95, 16.00 - 20.00, 3.14 - 10.86 and 7.64-16.86 g/100 g respectively, while that of the cooked ranged from 6.67 - 15.24, 14.50 - 26.00, 2.74 - 6.23 and 10.27 - 22.76 g/100 g respectively. Raw African spinach had the highest (9.59 mg GAE/g), while Water leaf had the least (7.03 mg GAE/g) total phenol content. For the cooked, African spinach have the highest (8.11 mg GAE/g), while Curry leaf have the least (6.08 mg GAE/g). Conversely, Raw bitter leaf has the highest total flavonoid content (11.94 mg QE/g), but raw Curry leaf (1.87 mg QE/g) had the least. African spinach has the least (1.89 mg QE/g) total flavonoid, while Bologi leaf (4.61 mg QE/g) had the highest. Scent leaf had the lowest estimated glycemic index (eGI), while Bush-buck had the highest. Enzyme inhibitions was championed by bitter and water leaves respectively. The vegetables' low glycemic indices and enzyme inhibitions effect could be used to deal with and prevent type 2 diabetes.

Keywords: Starch content, Amylose/amylopectin, Diabetes, Estimated glycemic index, Hyperglycemia.

Introduction

The position occupied by Green leafy vegetables (GLVs) among other food crops remains prominent, as they availing necessary nutrients, vitamins, minerals, fibers and medicinal value for health,[1,2,3] hence, the reduced consumption of GLVs in diets has been reported as a major factor leading to vitamin and iron deficiency.[4] In addition, GLVs are known to have low glycemic indices,[5] Glycaemic index (GI), however, put foods in the hierarchy of their entire effect on blood glucose levels[5]. The estimated GI (eGI) measures the rate at which consumption of a certain type of food could raise blood sugar level. A steady and gradual rise in blood sugar is ensured as a result of the consumption of low glycemic food, while a high glycemic food spikes the blood sugar concentrations quickly, and if not control, could lead to a condition known as hyperglycemia.[6,7]
Hyperglycemia is rise in blood glucose level, in which its persistence could cause obesity-induced type-2 diabetes mellitus (T2DM), if not control.[8] However, reports have shown that repression of pancreatic α-amylase and intestinal α–glucosidase activities could be explore to regulate availability of glucose and its absorption into the blood stream[9,10] According to the report of da Silva Dias[5], GLVs are rich in dietary fiber, phytochemicals such as polyphenols, that is capable of inhibiting these enzymes, thereby could reduce sudden rise in postprandial blood glucose. Although, the effect of cooking on the nutritive value such as minerals and vitamin contents of GLVs has been widely reported,[11,12] as GLVs most often subjected to cooking before consumption in Nigeria, but the effect of cooking on glycemic indices of some indigenous leafy vegetable has not been reported. This is why this research focuses on studying the effects of cooking on phenolics, inhibition of carbohydrate hydrolysis enzymes of certain native GLVs, and their corresponding glycemic indices.

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Materials and Methods

Sample collection and preparation of the extracts
Ten (10) leafy vegetables were collected freshly from different farm lands around Akure metropolis in the month of May 2016, and were processed using the method described by Adedayo *et al.*,[13]

Chemicals and reagents
This includes quercetin, Folin–Ciocalteu's reagent, Porcine pancreatic α-amylase (EC 3.2.1.1) and *α*-glucosidase (EC 3.2.1.20) from Saccharomyces cerevisiae, p-nitrophenyl-*α*-D-glucopyranoside, starch, gallic acid were procured from Sigma-Aldrich, Inc., (St Louis, MO).

Determination of total phenol and flavonoid contents.
The total phenol content (TPC) was determined using a modified method reported by Adedayo *et al.*[13], using Folin-Ciocalteau's reagent (v/v) method and expressed as gallic acid equivalent (GAE), while The total flavonoid content (TFC) was in accordance with the report of Akomolafe *et al.*[14] Both TPC and TFC were subsequently calculated using the formula below:

$$TPC = Abs_{sample} * Conc_{std\ (mg/ml)} / Abs_{std} * Conc_{sample\ (g/ml)} \quad \text{……… (Eq. 1)}$$

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where Abs_{sample}, Abs_{std}, $Conc_{std}$ and $Conc_{sample}$ connotes absorbance of the sample and standard, concentration of the standard and the sample, respectively.

α-Amylase and α-glucosidase inhibition assays
Sodipo *et al.*,[15] method was used to ascertain α-amylase inhibitory activity of the samples using soluble starch as substrate, while 5 mM p-nitrophenyl-α-D-glucopyranoside was used as substrate to determine α-glucosidase inhibitory activity described by Olagunju et al.[16] The results were calculated and expressed as percentage inhibition using the below equation:

$$Inhibition(\%) = \left[(Abs_{ref} - Abs_{sam}) / Abs_{ref}\right] \times 100$$

where Abs_{ref} is the absorbance without the extract and Abs_{sam} is the absorbance with the sample

Starch and Soluble sugar determination
Free sugar content was determined by extracting 20 mg of the pulverized sample using 80% hot ethanol, and the residue was used for soluble starch analysis using the detailed protocol of Oboh *et al.*[17]

Amylose and amylopectin contents and estimated glycemic index determination.
Amylose and amylopectin contents of the studied samples were carried out using the method described by Adefegha *et al.*,[18] while estimated glycemic index (eGI) was in accordance to the report of Babatola *et al*.[19]

Statistical analysis
This was carried out by analyzing the triplicate readings, which were pooled together and expressed as mean ± standard deviation (STD), and compared by one-way ANOVA. The least significant differences (LSD) were carried out and accepted at $p \leq 0.05$. IC_{50}, is designated as effective concentration at 50% ability of the sample, were calculated using non-linear regression analysis.

Results and Discussion

Estimation of total phenolic (phenol and flavonoid) contents
The TPC and TFC of the studied vegetables, are presented in Table 1. The TPC of the studied vegetables ranged from 7.03 to 9.59 mg GAE/g, while raw water leaf had the lowest and African spinach had the highest. Consequent upon cooking, the TPC ranged from 6.08 to 9.59 mg GAE/g, where scent leaf had the highest and curry leaf the lowest. Also, the TFC of the aqueous extract of the vegetable is presented in Table 1.
Cooking also increased the TFC of the Curry, Fluted pumpkin, Bologi, and False cubeb leaves, while it reduced the TFC of the remaining varieties, when compared with the TFC of the raw, which ranged from 1.87 to 11.94 mg QUE/g with Bitter leaf having the highest TFC, while Curry leaf had the lowest. The cooked samples, however, had the TFC ranging from 1.89 to 5.10 mg QUE/g with African spinach had the lowest and false cubeb leaf had the highest. Phenolic compounds are widely distributed in vegetables. Flavonoids, as a sub-class of phenolics, are also found abundantly in vegetables. However, most studies on the effects of heat treatment on the TPC have their results contradicting. Some reported increase in the phenolic content by some researchers, while others observed a decrease.[20]. In this study only scent leaf had an increase phenolic content. Cooking has also been reported to have a contradictory effect on the TFC of vegetables, as it either increases or decreases the flavonoid content. However, according to the Sukranso *et al*.[21] the increase flavonoid content could be due to its extractability or de novo formation between flavonoid precursor and other available phenylpropanoid in the tissue, powered by cooking. In addition, Yamaguchi *et al.*[22] hypothesized that boiling temperature inactivate polyphenol oxidase, thus, increase flavonoid availability in the tissue, while it could also decreased flavonoid content by leaching into the surrounding water. Aside from scent leaf that had a noticeable increase in its phenol content after cooking, other vegetable varieties had a decrease in their phenolic content after cooking.

Estimation of hydrolyzing enzymes (α-amylase and α-glucosidase) inhibitory potentials
The inhibitory potential of the vegetable varieties on starch hydrolyzing enzymes as determined by their IC_{50} value are presented in Table 2. The result shown that cooking reduced α-amylase inhibitory potential of the studied vegetables, except for wild spinach, fluted pumpkin and Brush buck, when compared to the extract from raw. But, increased α-glucosidase inhibitory potential of all the tested vegetables except for bitter leaf were observed. The raw samples ranged from 0.36 - 1.35 mg/ml, while when cooked the values ranged from 0.56 - 1.47 mg/ml for the α-amylase inhibitory potential of the samples. Furthermore, the α-glucosidase inhibitory potential of the raw vegetable varieties ranged from 0.58 - 1.16 mg/ml, while that of the cooked ranged from 0.38 to 0.78 mg/ml. Cooking however, doesn't have a similar effect on the α-glucosidase inhibitory potential of the vegetable varieties, as it decreases the inhibitory potential of bitter leaf and bologi on α-glucosidase while it increased the rest varieties.

The starch hydrolyzing enzymes; α-amylase and α-glucosidase are key enzymes that have been linked with T2DM.
Their inhibition prevents a quick breakdown of starch into simple sugars (glucose), thus, preventing hyperglycaemia. Reports has shown that phenolics are good inhibitors of starch hydrolyzing enzymes.[23] Hence, inhibition of these enzymes could be the functions of the phenolics present in the studied samples, therefore, could be among the possible mechanism of actions by which these vegetables exert their anti-T2DM effect. The increased inhibition of α-glucosidase activity could be due to the increased flavonoid content, as flavonoids are potent inhibitor of α-glucosidase activity;[24] the effect that is evident in scent leaf upon cooking. However, it is important to note that Wild spinach, water leaf, brush buck and African spinach have decreased phenolic and flavonoid contents, but exhibited stronger inhibition of hydrolyzing enzymes.

Estimated glycemic index determination
Leafy vegetables are plant parts consumed by humans as a meal or as part/constituents of some certain meals. They are generally known with low carbohydrates and fats, but endowed with vitamins, fibers and minerals[25]. Given that they have a low carbohydrate content and high in fiber, thus could confer low glycemic index (GI) properties. Cooking has been associated with increased GI from previous studies as cooking is believed to induce gelatinization. This causes a disruption in the structure of the starch complex, particularly interfering with the amylose-amylopectin structure, thus exposing it to digestive enzymes and thus raising the GI. [26] Depending on choice, vegetables are either consumed raw or processed before eating. The Table 3 presents effect of cooking on the eGI of the studied leafy vegetables. Interestingly, this is the first time the eGI value of the leafy vegetables will be evaluated. The eGI of the raw samples ranged from 26.59 to 40.45%, with scent leaf having the lowest, while brush buck had the highest eGI value. Consequent upon cooking, the eGI ranged from 23.64 - 38.51%; Fluted pumpkin had the lowest eGI (23.64%) value, while scent leaf had the highest eGI value (38.51%). The result reveals that cooking further reduced the eGI value of the studied leafy vegetables, but increased that of the scent leaf and water leaf, while that of the African spinach leaf remained constant. It is believed that these occur as a result of the cooking effect on the vegetables' GI, namely, the sugar and starch content and the amylose/amylopectin ratio of these vegetable varieties.

Estimation of free sugar and total starch content
The total free mono and disaccharides present in a food is referred to as the free sugar content of that food.[27] Also, The total starch content of the ten vegetable varieties is presented in Table 4. For raw; the total starch content ranged from 16.00 - 20.00 g/100 g with False cubeb and fluted pumpkin having the lowest starch content, while bitter leaf and African spinach had the highest

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On the other hand, the starch content of the cooked ranged from 14.50 - 26.00 g/100 g, where bitter leaf had the lowest starch content and wild spinach the highest. Our findings confirmed that cooking had a dissenting effect on the total starch content of the studied vegetables, as it increases the content of the starch, except for Curry, bitter, water, and bush buck leaves. Table 4 also shows the free sugar content of the ten vegetable varieties. The levels of the free sugar of the raw vegetables were from 7.86 to 15.95 g/100 g, with Curry leaf having the lowest free sugar content and Bush buck having the highest. However, when cooked, the free sugar content of the varieties ranged from 6.67 - 15.24 g/100 g with Bologi having the lowest and Scent leaf having the highest free sugar content. Cooking decreased the free sugar contents of a majority of the vegetable varieties except for Scent and wild spinach leaves. Previous report on the effect of cooking on some vegetables revealed that cooking decreased free sugar content (Xu *et al.*[28]). It is possible that the loss of free sugar content could be as a result of leaching of sugar into surrounding water. Also, the hydrolysis of starch content upon cooking could be responsible for the noticed increase of the sugar content of some of the vegetable varieties as cooking disrupts the starch structure, thus, might have led to the breaking off of some sugar molecules from the starch structure during cooking.

Amylose, amylopectin and amylose/amylopectin ratio content of selected GLVs

The amylose and amylopectin contents, as well as their ratio are presented in Table 2. The result shows that cooking decreases the amylose content of the studied vegetables. The amylose content ranged from 3.14 - 10.86 g/100 g of raw, with African spinach having the lowest and wild spinach having the highest amylose content. However, upon cooking, there was a reduction in the amylose content, which ranged from 2.74 - 6.23g/100 g. False cubeb had the lowest while fluted pumpkin had the highest. Furthermore, the amylopectin content of the samples is reported in Table 5. The amylopectin content of the raw samples ranged from 7.64 - 16.86 g/100 g, while that of the cooked ranged from 10.27 - 22.76 g/100 g, with raw wild spinach having the lowest and raw African spinach having the highest amylopectin content.

Table 1: Total phenol and Total flavonoid contents of aqueous Extracts of Some Nigerian Green leafy Vegetables

	Total Phenol (mg GAE/g)		Total Flavonoid (mg QUE/g)	
Samples	**Raw**	**Cooked**	**Raw**	**Cooked**
Scent leaf	9.19 ± 1.53^{f}	9.59 ± 0.57^{i}	7.90 ± 0.09^{i}	2.20 ± 0.02^{c}
Curry leaf	7.30 ± 0.76^{b}	6.08 ± 0.19^{a}	1.87 ± 0.09^{a}	2.13 ± 1.24^{b}
Wild spinach	7.97 ± 0.19^{d}	6.76 ± 1.53^{d}	2.82 ± 0.03^{c}	2.60 ± 0.15^{e}
Bitter leaf	8.92 ± 0.38^{e}	6.22 ± 0.76^{b}	11.94 ± 0.13^{j}	4.34 ± 0.05^{g}
Fluted pumpkin	9.19 ± 3.44^{i}	8.11 ± 1.15^{g}	3.51 ± 0.08^{d}	3.52 ± 0.13^{f}
Bologi	7.70 ± 0.57^{c}	7.16 ± 0.19^{f}	3.74 ± 0.03^{e}	4.61 ± 0.11^{h}
Water Leaf	7.03 ± 0.38^{a}	6.35 ± 0.19^{c}	5.44 ± 0.25^{h}	2.56 ± 0.14^{d}
False cubeb	9.46 ± 1.15^{g}	8.38 ± 0.38^{h}	2.28 ± 0.11^{b}	5.10 ± 0.16^{i}
Brush buck	7.97 ± 2.48^{d}	6.89 ± 0.19^{e}	4.99 ± 0.19^{g}	2.20 ± 0.19^{c}
African spinach	9.59 ± 0.57^{h}	8.11 ± 0.38^{g}	4.59 ± 0.09^{f}	1.89 ± 0.08^{a}

Values represent mean ± standard deviation of triplicate readings. Superscripts with different alphabets along the same column are significantly ($P < 0.05$) different.

Table 2: IC_{50} Values of Aqueous Extracts of Some Nigerian Green leafy Vegetables on α-Amylase and α-Glucosidase activities (mg/mL)

	Alpha amylase (mg/mL)		Alpha glucosidase (mg/mL)	
Samples	**Raw**	**Cooked**	**Raw**	**Cooked**
Scent leaf	0.88 ± 0.02^{h}	1.30 ± 0.02^{g}	0.89 ± 0.04^{g}	0.49 ± 0.03^{d}
Curry leaf	0.57 ± 0.02^{e}	1.47 ± 0.03^{h}	1.16 ± 0.04^{i}	0.40 ± 0.04^{b}
Wild spinach	1.35 ± 0.03^{j}	1.20 ± 0.02^{f}	0.89 ± 0.03^{g}	0.42 ± 0.03^{c}
Bitter leaf	0.36 ± 0.03^{a}	0.56 ± 0.00^{a}	0.58 ± 0.03^{a}	0.75 ± 0.00^{h}
Fluted pumpkin	0.63 ± 0.02^{g}	0.80 ± 0.01^{e}	0.92 ± 0.00^{h}	0.74 ± 0.06^{g}
Bologi	0.38 ± 0.02^{b}	0.62 ± 0.01^{c}	0.76 ± 0.02^{d}	0.78 ± 0.06^{i}
Water Leaf	0.48 ± 0.02^{c}	1.20 ± 0.01^{f}	0.66 ± 0.02^{b}	0.38 ± 0.06^{a}
False cubeb	0.56 ± 0.06^{d}	0.58 ± 0.05^{b}	0.80 ± 0.02^{e}	0.42 ± 0.03^{c}
Brush buck	1.07 ± 0.06^{i}	0.75 ± 0.04^{d}	0.85 ± 0.02^{f}	0.50 ± 0.03^{e}
African spinach	0.60 ± 0.04^{f}	0.62 ± 0.01^{c}	0.74 ± 0.02^{c}	0.52 ± 0.00^{f}

Values represent mean ± standard deviation of triplicate readings. Superscripts with different alphabets along the same column are significantly ($P < 0.05$) different.

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Table 3: Estimated Glycemic Index (eGI) of Some Nigerian Green leafy Vegetables

	eGI(%)	
Samples	**Raw**	**Cooked**
Scent leaf	26.59 ± 4.53^{a}	38.51 ± 0.91^{i}
Curry leaf	28.46 ± 9.37^{c}	27.28 ± 1.49^{b}
Wild spinach	38.37 ± 2.53^{f}	36.81 ± 7.88^{h}
Bitter leaf	34.78 ± 2.40^{e}	35.62 ± 0.23^{g}
Fluted pumpkin	27.39 ± 3.80^{b}	23.64 ± 4.71^{a}
Bologi	38.83 ± 2.40^{g}	35.11 ± 0.63^{f}
Water Leaf	31.87 ± 1.40^{d}	33.71 ± 3.62^{d}
False cubeb	40.00 ± 4.84^{h}	34.32 ± 4.39^{e}
Brush buck	40.45 ± 2.63^{i}	29.64 ± 10.50^{c}
African spinach	34.62 ± 2.85^{g}	34.62 ± 4.30^{e}

Values represent mean ± standard deviation of triplicate readings. Superscripts with different alphabets along the same column are significantly (P < 0.05) different.

But upon cooking, cooked false cubeb had the highest while cooked bitter leaf had the lowest. For majority of the vegetable varieties cooking caused an increase in the amylopectin contents, meanwhile water leaf and bitter leaf had reduced amylopectin content The amylose/amylopectin ratio showed that raw fluted pumpkin had the highest and raw African spinach the lowest, while cooked bitter leaf and cooked fluted pumpkin had the highest, while cooked false cubeb had the lowest. Amylose (linear glucose polymer) and amylopectin (branched glucose polymer) are two glucose polymers linking up to form a unit of starch.[29] An elevated amylose/amylopectin ratio was found to induce low hyperglycaemia and insulin responses, which is in stark contrast to similar products with low amylose/amylopectin ratio; these ones induce high blood glucose level.[30] Bitter leaf and Fluted pumpkin had the highest amylose/amylopectin ratio (0.41) when cooked with a corresponding low eGI (23.64%), recorded for the cooked fluted pumpkin. Generally, cooking significantly reduces the amylose/amylopectin ratio of the studied vegetables, as evidenced in the studied vegetable's amylose/amylopectin ratio. This reduction can be attributed to an increased randomness in the starch granule structure, which causes swelling and leading to loss of soluble amylose molecules during cooking.[31] Previous report has indicated that differences in cultivars, higher water content and higher water diffusivity could be the probable reasons for the difference in the reaction of the starch and sugar contents of food substances to cooking.[32]

Table 4: Free Sugar and Total starch contents of Some Nigerian Green leafy Vegetables

	Sugar (g/100g)		**Starch (g/100g)**	
Samples	**Raw**	**Cooked**	**Raw**	**Cooked**
Scent leaf	11.19 ± 0.34^{c}	15.24 ± 1.35^{f}	17.00 ± 0.00^{c}	21.50 ± 2.12^{e}
Curry leaf	7.86 ± 0.34^{a}	7.38 ± 0.34^{a}	19.50 ± 0.71^{e}	18.00 ± 0.00^{d}
Wild spinach	8.81 ± 0.34^{b}	10.48 ± 0.00^{c}	18.50 ± 0.71^{d}	26.00 ± 1.41^{f}
Bitter leaf	15.48 ± 1.01^{ef}	12.62 ± 1.01^{cd}	20.00 ± 0.00^{e}	14.50 ± 0.71^{a}
Fluted Pumpkin	14.76 ± 0.67^{e}	13.57 ± 0.34^{d}	16.00 ± 0.00^{b}	21.50 ± 3.54^{e}
Bologi	11.90 ± 0.67^{c}	6.67 ± 0.00^{a}	16.50 ± 0.71^{b}	18.50 ± 2.12^{d}
Water Leaf	11.90 ± 0.67^{c}	9.76 ± 0.34^{b}	19.00 ± 0.00^{de}	16.50 ± 0.71^{b}
False cubeb	13.81 ± 0.00^{d}	7.86 ± 3.03^{a}	16.00 ± 0.00^{b}	25.50 ± 0.71^{f}
Brush buck	15.95 ± 0.34^{f}	9.29 ± 0.34^{b}	19.00 ± 1.41^{de}	16.50 ± 0.71^{b}
African spinach	8.81 ± 0.34^{b}	7.86 ± 0.34^{a}	20.00 ± 0.00^{e}	25.50 ± 4.95^{f}

Table 5: Amylose, amylopectin and amylose/amylopectin ratio content of Some Nigerian Green leafy Vegetables

	Amylose(g/100g)		**Amylopectin(g/100g)**		**Amyl/Amylp**	
Samples	**Raw**	**Cooked**	**Raw**	**Cooked**	**Raw**	**Cooked**
Scent leaf	6.03 ± 0.34^{d}	3.74 ± 0.35^{e}	10.97 ± 0.34^{d}	17.76 ± 1.77^{e}	0.55^{bc}	0.21^{b}
Curry leaf	7.48 ± 0.34^{d}	3.99 ± 0.00^{f}	12.02 ± 0.37^{e}	14.01 ± 0.00^{bc}	0.62^{bc}	0.28^{c}
Wild spinach	10.86 ± 1.02^{e}	3.49 ± 0.00^{d}	7.64 ± 1.73^{a}	22.51 ± 1.41^{f}	1.42^{f}	0.15a
Bitter leaf	7.24 ± 0.68^{cd}	4.23 ± 0.35^{g}	12.76 ± 0.68^{ef}	10.27 ± 0.35^{a}	0.57^{bc}	0.41^{d}
Fluted pumpkin	7.97 ± 1.02^{d}	6.23 ± 0.35^{h}	8.03 ± 1.02^{ab}	15.27 ± 3.18^{d}	0.99^{e}	0.41^{d}
Bologi	6.76 ± 0.68^{c}	3.74 ± 0.35^{e}	9.74 ± 0.02^{c}	14.76 ± 1.77^{cd}	0.69^{cd}	0.25^{bc}
Water Leaf	5.55 ± 1.02^{b}	3.24 ± 0.35^{c}	13.45 ± 1.02^{f}	13.26 ± 1.06^{b}	0.41^{b}	0.24^{b}
False cubeb	7.24 ± 2.05^{cd}	2.74 ± 0.35^{a}	8.76 ± 2.05^{bc}	22.76 ± 0.35^{f}	0.83^{de}	0.12^{a}
Brush buck	7.00 ± 0.34cd	3.24 ± 0.35^{c}	12.00 ± 1.07^{e}	13.26 ± 1.06^{b}	0.58^{bc}	0.24^{b}
African spinach	3.14 ± 0.34^{a}	2.99 ± 0.00^{b}	16.86 ± 0.34^{g}	22.51 ± 4.95^{f}	0.19^{a}	0.13^{a}

Values represent mean ± standard deviation of triplicate readings. Superscripts with different alphabets along the same column are significantly (P < 0.05) different.

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Conclusion

This study revealed that cooking has diverse effects on the GI, phenolic content, α-amylase and α-glucosidase inhibitory properties of the selected GLVs. These effects could be attributed to factors such as the cultivar, water content, water diffusivity, dietary fibre, among others. In addition, since the selected GLVs exhibited relatively low eGI and inhibited enzyme activities; consequently, intake could therefore be explore in prevention of obesity-induced T2DM.

Conflict of interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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